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INDIAN FARMING

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HORTICULTURAL INDUSTRY IN INDIA*

ALTHOUGH the horticultural industry is yet in its infancy, the horticultural science has made rapid strides in the country.

The industry is in its infancy because there is no organization or agency in this country through which largescale application of horticultural science could be made to the development of horticultural industries. Consequently the industry is not developed and there is so much dearth of production. The present situation in this country is that with us plenty is actually synonymous with scarcity and the counterpart of millions and billions in the United States of America is only tens and hundreds in the Indian Union. There is at present great difficulty in securing fruits and vegetables for fresh consumption. The present production falls far too short of demand. The result is that it is very difficult to make any headway in developing the preserve industry.

However, the horticultural science as such is fairly well-advanced. The high level of floriculture and landscape gardening of India enjoys an international reputation. Indian horticultural practices such as root exposure, axing of jack trees and bending of trees are so fully advanced and mastered by our gardeners and orchardists that even leaves, blossom and fruit can be produced according to plan. These are the practices, the why and wherefore of which are yet to be discovered.

The unfortunate effect of the partition of the country, however, as in so many other directions, is also felt in the domain of horticultural development. Important tracts of citrus cultivation have had to be handed over to Pakistan. Large tracts of temperate fruits such as apple, apricot, plums and peaches that existed in Baluchistan and N.W.F.P. have been lost. We have, therefore, a double task confronting us as a direct result of partition, namely, (i) to improve our existing fruit orchards and their yields in order to meet our needs, and (ii) to establish new orchards from which, at a later stage, we shall be able to derive luscious and nutritious fruits of varieties which we have had to part with.

It may be of interest to state that some of the provinces such as Madras, Bombay, the Punjab and the United Provinces have already organized regular horticultural sections and have opened up experimental fruit farms. The experimental work as well as the training of men in these provinces is making fairly good progress. Other provinces have also recognized the importance of this subject at least by appointing a skeleton staff.

The teaching of horticultural sciences is also making headway in various Universities. Opportunities for higher research degrees in horticulture are being provided at various centres.

The greatest fillip to this growing science in this country is given by the Indian Council of Agricultural Research. During the last twenty years, 40 schemes have been launched at a cost of Rs. 23,37,294. Several important aspects of this science have been touched, but there is still much to be done. Some very useful results have accumulated. These results are to some extent filtering across to the grower. Recently the Government of India have sent abroad 25 candidates drawn from all over the Indian Union for training in various branches of horticulture. The provinces have also sent their men to foreign countries. The Ministry of Agriculture have trained 18 candidates in Post-Graduate course in India itself.

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*Speech delivered by Dr. G. S. Cheema, D.Sc., I.A.S., Fruit Development Adviser to the Government of India, at the Second Horticultural Research Workers' Conference held at Madras on 21 May 1948.

Both pomology and fruit technology have had their share. A number of trained hands, although insignificant as compared with the vastness of the Union, will now be available for development work. What is wanted now is an opportunity to develop the horticultural industry of this country by furthering both scientific research as well as extension activities, so as to bring it on par with other agricultural developments and consistent with the national requirements.

The most urgent need of the present moment is to have an efficient central coordinating organization which can adequately deal with the central subjects such as import, export, inter-provincial activities and controls. It can at the same time conduct all fundamental research on problems of an all-India nature, as well as serve as a clearing house of the nation in subjects of horticulture. Such an agency could also be developed into a training centre such as may not be possible individually for provinces in India to establish. At any rate, it will be immensely useful for Centrally Administered Areas and newly organized State Unions. An institution run by the Central Government will be more economical and widely beneficial. Highly trained technicians are needed not only to plan the future policy, but also to supplement the work done in different provinces for the benefit of the growers and the canners. The recruitment of staff on a temporary basis, as is now being done, is a real bottleneck in dealing with horticultural development.

It seems doubtful if the importance and benefits of agricultural planning are as yet fully understood in this country. We are yet to make a serious beginning in this field. An attempt was made by the National Planning Committee to plan out various developments. But it resulted in a half-hearted effort and fizzled out. With our independence, planning has to be given a prominent place. At present we seem to be playing with it, or paying a scant attention to it.

We are still static and have not moved to organize ourselves. Organization is another field through which we have to protect the interest of the common man.

The foremost need of the present moment is undoubtedly to define the policy to be followed by a plan having a target in view. Upon our ability to organize and coordinate the results of various zones depends the success of such a policy. Then alone can useful results be carried across to the growers.

To augment the production of fruit in order to reach our target, to become self-sufficient, we need systematic extension of area under high-yielding and quality fruits. This can be done by carefully surveying and locating the important zones where areas can be extended under varieties that can be grown easily. The plan should be to develop variety zones so that the surplus produce can be economically linked with preservation. By cantoning of fruit areas in this way, opportunity will be afforded to horticultural workers to devote all attention to qualitative and quantitative improvements, so much desired in our commercial fruit crops. It will also then be easy to standardise planting material by regulating our nursery trade, the demand for which is so keenly felt. Above all, not only will the supply of protective food increase in the Union, but it will also enrich the cultivator and help him to raise his standard of living, because horticultural crops not only supply larger nutritive matter per unit space, but yield larger income than agricultural crops. For the ultimate success of all this set up, one requires an effective background of efficient organization and experimentation in this country.

At present there exists no effective and responsible organization for this purpose. The Centre cannot set up an organization on account of political and financial reasons. The provinces are naturally also unable to take up this function. This weakness at the Centre is responsible for the present impasse. The result is that even if any useful work is done in any province, it remains unknown.

There is also at present very little opportunity for fundamental or basic research. Neither the Centre nor the provinces have as yet set up any self-contained research stations. There is no trained staff nor any well-equipped laboratory of national importance for developing further the quality or quantity of our fruit crops. Consequently, we are not able to develop the industry on any scale.

Another great handicap impeding the fruit development in his country, is the lack of effective means of destroying insect pests and diseases. The Indian fruit trees are so graceful and their fruits so sweet and delicious that hordes of dangerous insects attack both the trees and fruits voraciously. We are not able to save them. Of course, this does not speak well of the custodians, but science has not yet reached a stage to be able to help us to destroy them. The fruit fly, the stem and fruit borer and moths are a few of our worst enemies. Widespread damage is also caused by diseases such as the mildew and pathological troubles like the die-back. No way to their economic elimination has yet been found. This offers a big field for our workers to investigate.

It is well-known that the fruit preserve industry is now a protected industry. The benefits of protection, however, are not being fully realized due to the scarcity of essential materials including raw produce. The preserve industry, therefore, is not developing as it might have done.

I have only touched in my remarks the bare outlines of our horticultural needs. The fact is that neither the Centre nor the provinces and States have paid sufficient attention to the development of fruit industry. It is really left for the modern horticulturists and our leaders now to plan our future and convince the nation to treat this science on par with other sciences. It is hoped that as a result of the labours of our young horticulturists combined with the sympathetic assistance by their Governments, the Indian horticulture will blossom forth to its logical goal worthy of its vast resources.

Original Articles

SOME ASPECTS OF GRADING & STANDARDISATION OF AGRICULTURAL PRODUCTS IN INDIA

By T. G. SHIRNAME

WE are all aware that the price a farmer gets for his produce is determined by the rates prevailing in terminal markets like Bombay or Calcutta. Even in the case of agricultural products, like fruits and vegetables, which normally do not move over long distances, the price a farmer receives is determined by the rates prevailing in the principal consuming centres like Delhi or Kanpur. For any one agricultural produce, the price in a terminal market or a consuming centre depends on the variety and quality of that produce. It is, therefore, very important that the rates so determined in the terminal or consuming market for a particular type or quality should be related to the type or quality of the farmers' produce with a view to see as to whether the farmer does or does not get a price on parity with the rates prevailing in the terminal or key markets. Every aspect of improvement in the agricultural marketing systems in any part of the world, therefore, depends very largely on the manner in which arrangements could be made to put the farmer in a stronger bargaining position from the point of view of his getting for the type and quality of his produce a rate on parity with prices prevailing for the same type and quality in the key markets.

Inevitable variations in agricultural products

But for this purpose, we must have standards for types and qualities of the agricultural produce. In any manufacturing industry, it is easy to put on the market, a product of standard quality which would not vary from month to month or from year to year. The manufacturer can do this because he can control and standardise all aspects of the manufacturing processes. In agriculture, on the other hand, such a control is not possible in so far as environmental conditions like soil, climate and rainfall are concerned. The type and quality of seed, the cultural practices and the methods of harvesting and preparing the produce for the market, which also determine quality, could however be controlled by the farmers.

Present practices

Yet even these controllable factors are not given the attention they deserve by the farmers mainly because of the present market practices in which dirt and dishonesty play a prominent part. The existing market practices are such as would discourage the farmers from putting on the market their produce properly cleaned and dried. It is commonplace in all the primary markets to find a considerable proportion of refraction and moisture in the products offered for sale. After the introduction of rationing, this seems to have increased and it is everyday experience of the consumer of rationed foodstuffs to find in his ration things which should not be there. This is, however, not a new development but is a legacy of the market practices which have evolved in this country during the past 100 years or so.

These market practices actually encourage the addition of dirt, stones and other foreign matters to agricultural produce even in terminal markets like Calcutta or Bombay. The methods of business are such as do not offer any or adequate premium for quality. This may be because the terms of contract on which

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the members of same trade associations conduct business, permit, as a necessary clause, a certain percentage of refraction without making any allowance for premium for such of the sellers who would deliver their produce in a more clean condition. Or it may be due to the indifference of the buyers to discriminate a good quality produce from a bad or indifferent lot. The business practices in port towns have been such as have actually resulted in earth, dirt, etc. being carried to and fro between the port town and the producing centres. Evidence is on record to indicate that earth or small stones from areas of production are actually packed and transported to port towns to be mixed with clean produce merely because the terms of business permit a certain percentage of refraction and to show that admixture took place in the producing area itself. *Vice versa* the excess of dirt or refraction separated in markets is transported back to the villages to be mixed with clean produce before being despatched to the markets. There have been instances on record of prominent business houses maintaining a specialized branch for breaking clods of earth into sizes, somewhat similar to the agricultural product like groundnut or linseed, so that those small particles of earth could be more easily mixed with the agricultural produce.

Such practices obviously discourage not only the producer but also a genuine trader who would like to do business in a straightforward manner. The amount of dirt, stones, etc. entering into the internal and foreign trade of the country is enormous. Taking the heavy staples like oilseeds and principal foodgrains like rice, wheat and millets, the total quantity of dirt involved in inter-provincial trading alone would be over 1,20,000 tons. The number of wagons and trainloads required for transporting this rubbish could be easily imagined. The quantity would be much larger if the trade within the provinces is taken into account. The movement of such a huge quantity of refraction and foreign matter involves an enormous waste of the cost of packing and transport and the occupation of valuable transport space. This excludes the excessive moisture contents found in most agricultural products. The practice of wetting the produce before sale is not uncommon, and if the transport and other wastes on this account are to be considered, the total loss would be at least twice, if not more. There is also another aspect, namely, the wetting of agricultural produce definitely results in further deterioration of the quality of the produce which would be otherwise sound without the excess moisture.

These practices of dirt and dishonesty also enter the country's foreign trade and it is well-known that the reputation of Indian agricultural produce in the international markets is not high. Yet, the Indian products continue to be sold in the foreign markets, mainly because they could be had at rates cheaper than those obtaining for similar products offered for sale by other countries. Apart from this question of nation's reputation in the international markets, the country spends huge sums of money every year on transporting refraction and other foreign matter along with sound produce. Taking the instances of only two commodities, like groundnuts and linseed, exported to foreign countries, it can easily be reckoned that prior to the outbreak of War in 1939, we were exporting something like 27,000 tons of earth, dirt, stones, etc. every year admixed with sound groundnuts and linseed. Statisticians can easily calculate the amount of shipping space and the number of steamers required for transporting this rubbish. The total sea freight paid over the transport of this rubbish of 27,000 tons to foreign countries at pre-1939 rates was of the order of Rs. 5,00,000. In addition, there was the cost of packing and the movement involved from the producing areas to the port towns like Bombay, Calcutta or Madras. This figure of loss on sea freight does not take into account the moisture contents of these oilseeds which can be reckoned easily at double the contents of the foreign matter. The huge loss on account of the refraction and excessive moisture contained in agricultural products traded within the country and exported abroad could therefore be easily imagined. The presence of excess moisture causes further deterioration by way of increased development of free fatty acids which spoil the quality of oilseeds and of the resultant oils.

The enormous loss to the country on account of such mal-practices is therefore obvious and it should be possible to avoid a considerable portion, if not the whole, of this loss by adopting better and modern methods of marketing.

The mal-practices are the main cause for lack of confidence between the primary producer on the one hand and the trader on the other. They also result in want of confidence amongst the tradespeoples themselves and not infrequently one tradesman tries to cheat the other. In so far as our foreign trade is concerned, such mal-practices can be hardly considered conducive for maintaining and improving the country's reputation in the international markets.

This has been the principal handicap to the Indian Government Trade Commissioners in promoting India's trade in foreign countries and everyone of them has been pressing for effective action for regulating the quality of India's exports in accordance with standard grades.

In the absence of such standards, a very large portion of India's foreign trade is conducted on consignment basis. In the absence of regulation on the quality of our exports, the foreign buyers prefer to inspect the produce before agreeing to buy. For this purpose, many of them have opened offices or agencies in India. Others prefer to buy after inspecting goods consigned to their countries for sale. The commission houses and brokers in foreign countries are therefore the agents who secure customers for our commodities consigned to foreign countries. During recent years, however, sale on the basis of sample has developed, but a very large number of such sales is followed by disputes and arbitration. The arbitration is arranged in countries where our produce is despatched and, as such, the Indian shipper has no effective voice in such arbitration. Normally, therefore, he has to accept the arbitration award.

In so far as our foreign trade is concerned, there is also another danger if matters are not improved by regulating the quality of our exports. Foreign manufacturers requiring Indian raw materials for their manufacturing processes, are greatly upset when they cannot get from India raw materials of the requisite quality from year to year. All such manufacturers must put on the market their manufactured goods in a standard form which must not vary from year to year. For the manufacture of such standard articles, they must be assured of a regular flow of raw materials of the requisite quality from year to year. Owing to indifferent qualities of shipments from India, they either try to buy from other countries or prefer the use of substitutes. In regard to the latter, i.e. substitutes, the cases of lac and jute are well-known. For the present we are deficit in jute but in so far as lac is concerned, we still hald a monopoly in the world. But we are slowly losing in the international lac market due, in a considerable extent, to the absence of standards in the quality of our shipments. Similar is the case in regard to carpet wool which we export very largely to the U.S.A. It is reckoned that out of 41·5 million pounds of carpet wool exported from the Dominion of India, not less than 10 million pounds consist of foreign matter. The carpet manufacturers in the U.S.A. therefore are always on the look out for alternative sources of supply and have expressed that they would greatly appreciate anything that India could do to see that the shipments from India take place either in accordance with standards of grades or the sample on which the sale between the Indian shipper and the foreign buyers was contracted.

Agmark grading

The importance of grade standards for our agricultural products is therefore obvious. It is important to the farmers, to the traders, to our manufacturers, to the exporters and to our foreign buyers. It is also important from the point of view of cutting down our losses by way of packing costs, transport costs and space costs due to shipment of unwanted materials to foreign countries and also the merchandising costs incurred on shipments sent on consignment to brokers and commission houses in foreign countries. An attempt towards the grading of agricultural produce on a statutory basis, for the country as a whole, was first made after the passing of the Agricultural Produce (Grading and Marking) Act, 1937. Under the provisions of this Act, standard (designated as Agmark) grade specifications could be prescribed for any produce of agriculture, animal husbandry and forestry. Though grading under the Agmark has been in existence for about 10 years, the quantity of produce graded is yet small, being worth a little over Rs. 10 crores. The slow progress is due to the fact that the Act is not absolutely binding on the producer. The tradespeople agree to the principle of grading, yet they have not yet taken kindly to it mainly on the ground that they already do their own grading and therefore it is not necessary for them to adopt any all-India specifications of the Agmark type. It is possible that they apprehend that recognition and adoption of the national or Agmark grades by all trade and manufacturers from within the country and by our foreign buyers might make it easier for newcomers to join the export trade, thus increasing competition. The commission houses and brokers in foreign countries have also not so far encouraged Agmark grading, presumably because they apprehend that the wholesale adoption of such grades by Indian shippers would ultimately stop exports on consignment and that foreign manufacturers requiring Indian raw materials would buy their requirements direct from Indian shippers, thus short-circuiting and saving their costs incurred over commission houses and brokers. A large number of Indian shippers quote such foreign commission agents and brokers as an authority in support of their unwillingness to trade on the basis of Agmark or national standards. Purchase agencies of Indian and foreign manufacturers also have not shown enthusiasm for Agmark grading for reasons which seem obvious and which need not be further explained. On the other hand, genuine manufacturers have expressed that they would appreciate if they could be assured of their raw materials from year to year, graded exactly in accordance with standards and without any variations in grading either from one supplier to another or from season to season with the same supplier.

Even the voluntary efforts in grading on the basis of Agmark standards have become quite popular. Agmark is now accepted as the standard of purity and quality in the case of many commodities like *ghee*, table butter, vegetable oils, etc. The Agmark products are fetching a premium. But this has also resulted in the misuse of Agmark and several cases have recently come to light wherein the Agmark label has been either imitated or counterfeited or the contents under the Agmark seal were found either tampered with and adulterated or absolutely off the Agmark specifications. Cases are also on record where financing agencies like banks were cheated by way of taking advances on stored containers sealed with the Agmark label but containing cement, stones and other foreign materials. This clearly indicates that the national standards could also be misused and serve as another item of mal-practice for committing deceit and fraud.

Having regard to the existing trade practices, at least some of which could be hardly considered satisfactory and creditable, the problem of enforcement of the national or Agmark standards is therefore an important and urgent issue. The most ideal way of enforcing such standards woud be for the trade itself to enforce them. But considering the organization and working of even the more prominent trade associations in the country, it is doubtful if the trade could be depended upon for the effective enforcement of such standards. From what has been discussed earlier in this paper, it is obvious that the enforcement of standards is important in all markets primary, secondary and terminal. A well-organized trade association can at best enforce its decisions when the transaction takes place between two of its members. It is, therefore, difficult to foresee how the trade would be in a position to enforce standards for the country as a whole. Even in agriculturally advanced countries, like the U.S.A. and Australia, the enforcement of the standards of quality is done by the State itself, directly and indirectly. In Australia, the quality of all exports of agricultural produce is controlled by the Commonwealth Government through its various Commodity Marketing Boards. In the U.S.A. the Federal Department of Agriculture inspects quality through its elaborate Inspection Service and the licensed Inspectors.

Regulating the quality of India's exports

This leads me to give a brief account of the efforts made in India for regulating the quality of our exports. After the outbreak of War in 1939, the Government in the U.K. repeatedly complained about the bad quality of exports from India, particularly in regard to tobacco and sann hemp. It was reported that the quality of shipments was so bad that considerable sum of money was required to be spent in removing and destroying the unwanted rubbish shipped from India. In consequence, steps were taken by the Central Government to prohibit the export of tobacco and sann hemp from India excepting in accordance with Agmark standards. An elaborate Inspectorate staff now checks the quality of sann hemp and tobacco exported from India. The results have been very satisfactory, particularly in regard to tobacco. The results for sann hemp have not yet been so spectacular, entirely because of the opposition of the trade to the Government intervention. The trade is, however, slowly adjusting itself and there are reasons to believe that in regard to sann hemp also the results would be as satisfactory as for tobacco. Prior to the introduction of compulsion in 1945 on the grading of tobacco before export, by far the largest part of exports sent by Indian shippers used to be on the basis of consignment. Some sales used to take place on the basis of samples also. Since the introduction of compulsory grading in 1945, our exports have progressively changed over to the basis of F.O.B. Indian port like Madras or Coconada. We are now getting firm quotations on the basis of Agmark grades with 100 per cent credit opened in India. This proves that our foreign buyers have accepted and are convinced about our Agmark grading. The banks in India are accepting our Agmark grading certificates for assessing the value of tobacco pledged with them for the purpose of determining the extent of financial advances. This facility is also being extended by the banks to other Agmark products like *ghee* and vegetable oils graded for consumption within the country. As the quotations on the basis of Agmark grades received from foreign countries are now quite open, the farmers have begun to take an active interest in those price quotations and to realize that if they grade and process their tobacco in accordance with Agmark specifications, they would get the same price as quoted, say by London, minus the expenses which they by now already know. They have been, therefore, put in a stronger bargaining position at the time of selling their produce to the local merchants or shippers. This is the objective of all marketing improvements and could be achieved by the adoption of standards of grades. The grading of tobacco has helped in making the tobacco-growers realize the importance of organizing themselves into a cooperative society and several hundreds of such growers together owning some 10,000 acres of tobacco have now come forward to form themselves into a cooperative society with the object of pooling their produce, processing and packing it and then selling the packed goods either to buyers in India or to foreign countries in accordance with the price advantage. The introduction of standards of grades has also resulted in increased competition amongst the tradespeople themselves. This competition has assisted in maintaining strictly the Agmark quality standards and giving to the farmer a more competitive price.

Utility of standard grades for price broadcasts

The adoption of such standards of grades for agricultural products in countries like the U.S.A., Canada, Australia and New Zealand has greatly helped in evolving a system of price broadcasts with the object of letting the farmer know as to how much he should expect to get in his market for the type and quality of his produce. The United States Department of Agriculture has a tremendous organization for collecting and disseminating prices and has for this purpose taken on lease from Western Union a separate wire over a distance of some 10,000 miles for transmitting information on prices and market trends. For all the important markets in the 48 States, parity tables exist which enable the farmers and the local trade to calculate without any difficulty the local prices on parity with rates prevailing in key markets like New York, Chicago or New Orleans. The other countries have organized a similar price broadcast service. The farmer in those countries daily listens to the radio and the two items which he never misses on the radio are the weather and price broadcasts. There are many farmers even in these advanced countries who cannot read and write. Yet, they can always listen and the items which they like most to listen to are those on weather and the prices. In the scheme of village broadcasts in this country, the farmers' economic and social welfare must inevitably play the most important part. His economic position would largely depend on his getting the correct price. For this he must know every day as to how much price he should expect to get in his market for the type and quality of his produce. This would be feasible only after we agree to adopt universally standards of grades or quality for our agricultural products.

MANURE PRODUCTION IN VILLAGES

By C. N. ACHARYA

IN spite of the propaganda carried out by Agricultural Departments during the last two or three decades, it must be admitted that the method of manure preparation in villages remains as crude and unsatisfactory as it was before. In fact the position may be said to be becoming worse, since due to fuel scarcity, increasing quantities of cow-dung are being burnt for fuel in villages as well as in the adjoining towns. The reasons for the above unsatisfactory position may be summed up briefly as follows:

(a) The insufficient staff maintained by Agricultural Departments, who are unable to attend to even a fraction of the villages entrusted to their charge; (b) the 'poor' contact which the agricultural officers have as a general rule with the villagers, due to a defect in the 'outlook' and 'method of approach' adopted by them; (c) the absence of a proper scheme for the improvement of manure production in villages, which would aim at arousing the enthusiasm of villagers for improving themselves and the country as a whole.

Though exact statistics are not available, some idea of the huge quantities of manure now going to waste in our rural areas as compared to our use of oilcakes and chemical fertilizers is given in Table I.

TABLE I

Present position and scope for development of organic manures in India

Type of manure	Present position		Potential capacity		Extra nitrogen required to produce extra 5 million tons of foodstuffs
	Quantity estimated to be applied to land at present	Total nitrogen contained	Quantity	Total nitrogen	
	Tons	Tons	Tons	Tons	Tons
1. Farmyard manure and compost	200 million (containing about 50 per cent moisture)	750,000 (containing about 0·35 per cent nitrogen in the manure)	400 million	3 million	Extra one million tons nitrogen required
2. Oilcake	8 lakhs	0·4 lakh	15 lakhs	0·75 lakh	
3. Chemical fertilizers	3 lakhs	0·6 lakh	..	..	

Glaring defects and fruitful remedies

The chief defects in manure preparation in our villages at present are:

(a) The failure to conserve as much of cattle urine as possible in manure preparation; (b) insufficient methods of storage of manure adopted at present; (c) the failure to collect available refuse from the farm and village surroundings and to utilize the same in the cattle shed for absorption of urine; (d) the present habit of burning cow-dung for fuel and (e) absence of any arrangements for conservation of human excreta and urine in villages.

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Items (a) and (c) may be considered together, since the refuse collected on farms or in the village is useful for absorbing urine in the cattle-shed. Simple methods of urine conservation as described by the writer in a previous issue of this journal[1] should be regularly adopted for this purpose. The Chinese farmer takes great pains to bring all available refuse to the village in order to prepare compost there; in addition, he prepares compost also on his farm, whenever the refuse is excessive and could not be brought to his cattle-shed. In Japan, from a cultivated area of about 14·8 million acres about 77 million tons of compost were prepared during the year 1945, which works out to an average of about five tons of compost per acre; whereas in India we are preparing about 200 million tons of manure only from a total cultivated area of about 200 million acres, which works out to an average of about one ton of compost per acre. Compost in Japan contains about 2 per cent of nitrogen (on the dry basis), while in India village cattle-shed manure contains only about 1·5 to 1·75 per cent nitrogen (on the dry basis). This low percentage of nitrogen is due to our negligence to conserve cattle urine.

As regards item (b) above, the present methods of manure preparation in villages, viz. in big, round pits which are exposed to leaching action by rain and to rapid drying by sun, or in over-ground dumps similarly exposed to rain and sun, are subject to heavy losses of humus and nitrogen. The losses are particularly serious in cases where attempts are made to raise the nitrogen percentage of the manure to 2 per cent and above (on the dry basis), by conservation of cattle-urine. In order to avoid such losses, the writer would strongly recommend the method of 'sectional filling of trenches' described by him in an earlier issue of this journal[2].

Regarding item (d) above, the burning of nearly 200 million tons of cow-dung every year for fuel purposes in villages and towns is something which does not occur in any other agricultural country of the world. This continued burning of the above colossal quantity of manure year by year is the one single major factor accounting for the low fertility of Indian soils and for our low crop yields as compared to other countries. It has already been mentioned that Japan produces nearly five tons of compost per acre of cultivated land, whereas India produces barely one ton of compost per acre under cultivation. Steps must be immediately taken to prevent the burning of cow-dung for fuel. This can be done effectively only by starting village fuel plantations, with the cooperation, labour and supervision of the villagers themselves, through their village *panchayats*. The Government should provide necessary facilities by way of expeditious requisitioning of land for the above purpose, supply of suitable seedlings, technical guidance and financial help, but the main urge in the matter should come from the villagers themselves. *Acacia* (*babul*) and *prosopis* come up quite easily in all areas and provide fuel in five or six years time. Others like *casuarina*, *shishum*, etc. have been successfully tried in special localities suited for their growth.

Item (e) relating to the conservation of human excreta and urine in villages is a field in which practically no work has been started so far. The Central Manure (Compost) Development Committee at its meeting held at Nagpur in July, 1948 were in favour of a largescale trial being given to the Wardha System of Trench Latrines. The above system has been tried with success at several village centres in the Central Provinces and Berar and is also being introduced on a large scale in Bombay Province. The method consists of constructing on the outskirts of the village brick-lined trenches 20 to 25 ft. long, 2 to 2½ ft. broad and 3 to 3½ ft. deep, provided with thatch bamboo-work sheds, divided into five or six partitions. Cross-pieces of planks or stone slabs are placed across the trench within each partition so as to form seats leaving 10 in. to 12 in. space between the planks. Heaps of earth or refuse are placed in front of each partition, so that after use the excreta are covered over immediately by the user with earth or refuse. A trench divided into six partitions would be sufficient for about 100 persons for nearly three to four months. After one trench gets completely filled up, another trench is dug behind and parallel to it and the superstructure of shed and partitions is shifted to the new trench.

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[1] Acharya, C. N. A simple method of conserving cattle urine. *Indian Farming*, **6**, 1945, p. 214.

[2] Acharya, C. N. Sectional filling of trenches in farmyard manure preparation. *Indian Farming*, **6**, 1945, p. 569.

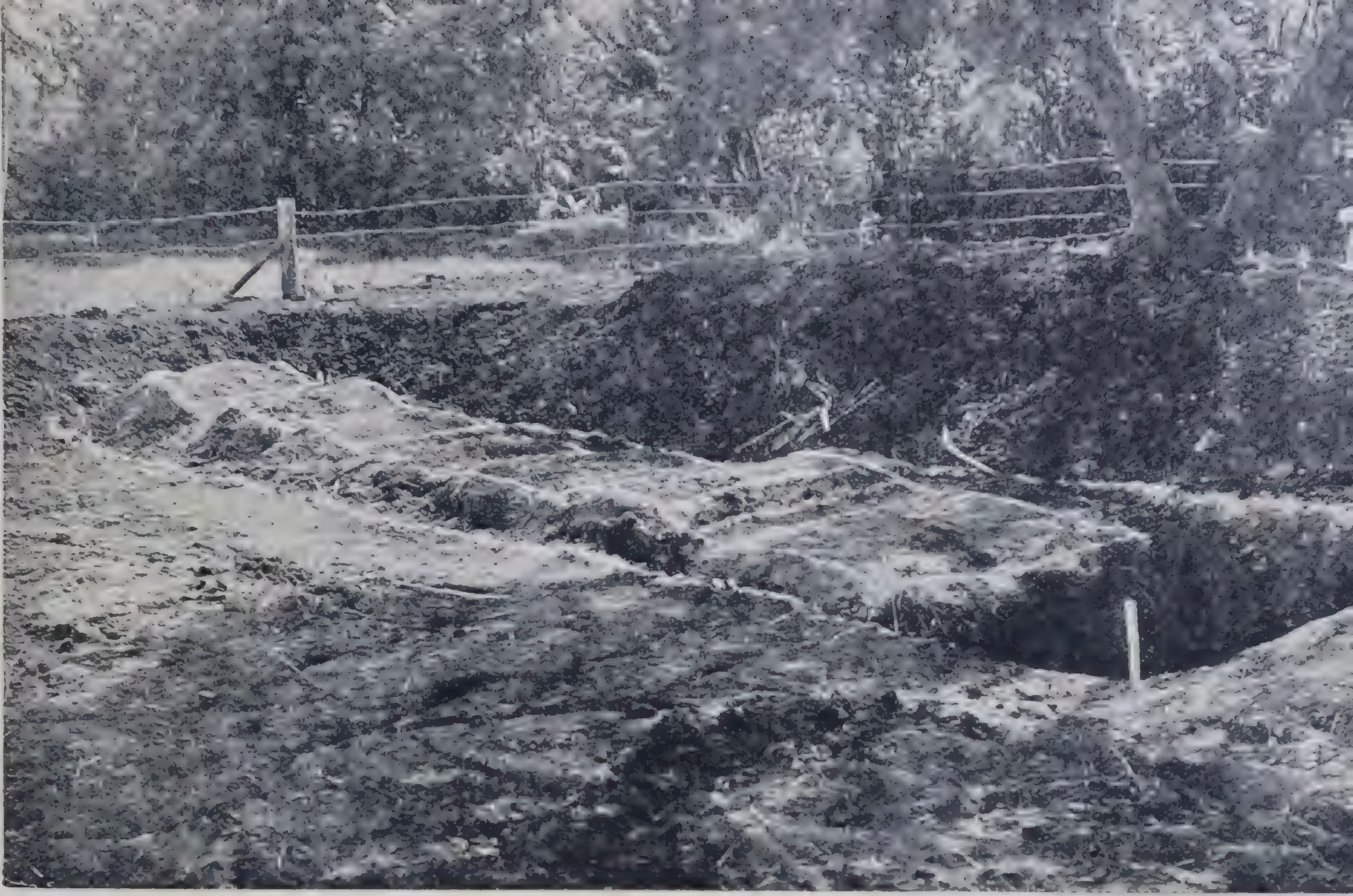

FIG. 1. (above) Sectional filling of trenches in village manure preparation.

FIG. 2. (below) Compost heaps on farms plastered over with earth.

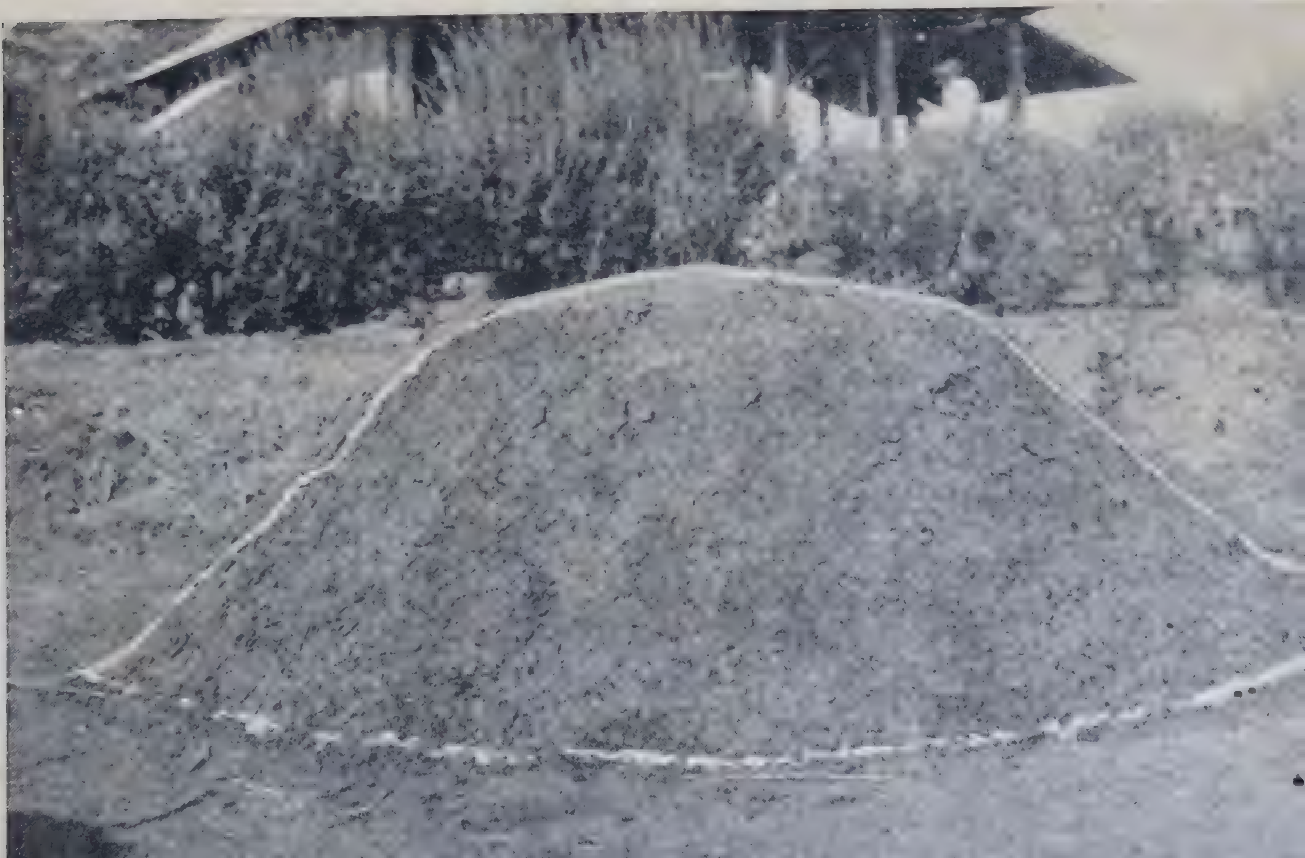

FIG. 3. Conservation of cattle-urine by spreading refuse in areas where urine soaks into the ground.

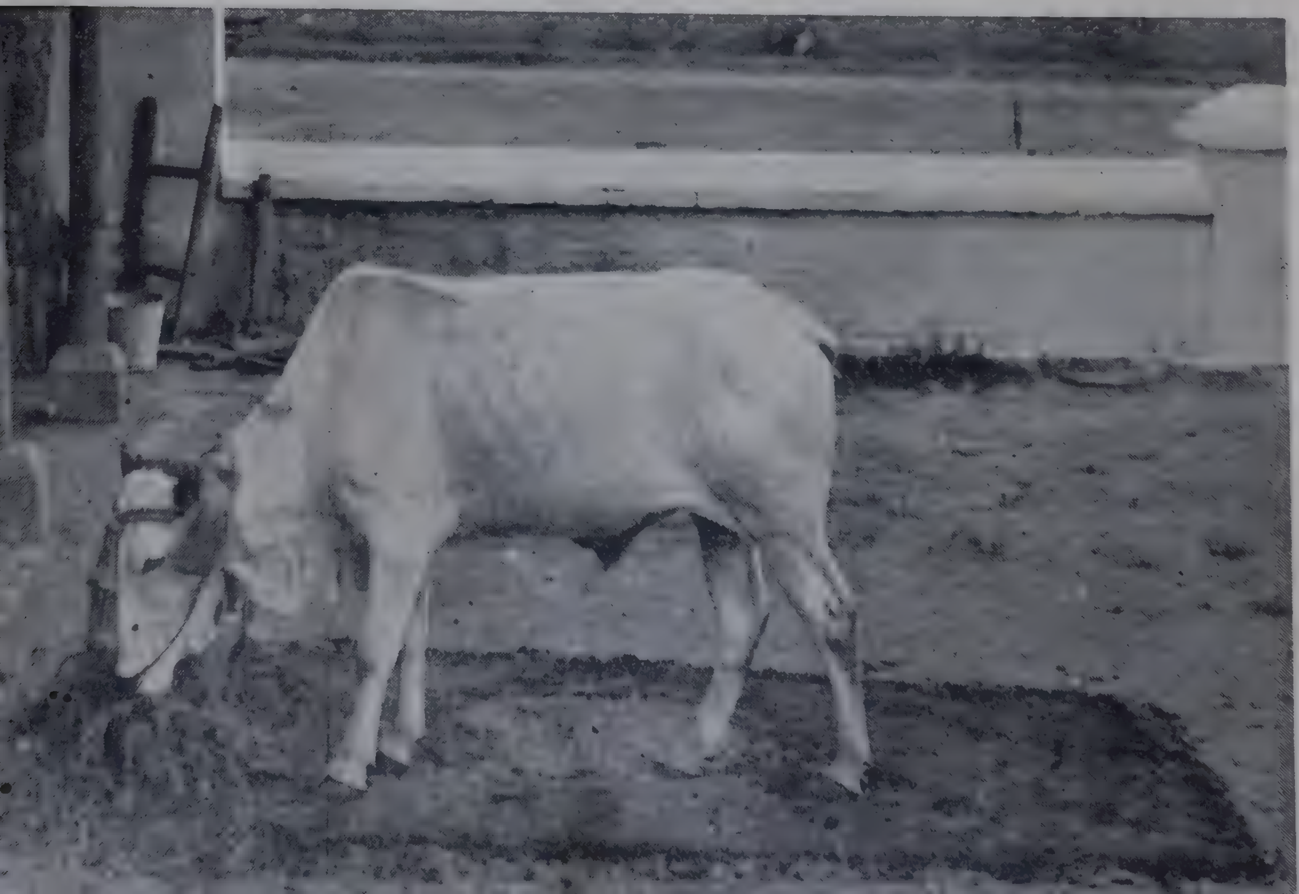

PLATE 2

By the time the second trench gets filled up, the contents of the first trench would have decomposed into manure and can be emptied out and re-used.

Fixing targets

A comprehensive programme of manure production for a village must therefore include provision for all the five items. The village *panchayat*, cooperative society or special *ad hoc* committee must take up responsibility for getting the cooperation of the villagers so that the programme can be carried out at minimum cost. Targets must be fixed for each year for (a) the volume of manure to be produced from cattle-shed and village refuse; (b) the number of fuel trees to be planted in the village surroundings or in special plots acquired by the Government for the purpose; (c) the quality of manure prepared, as judged by nitrogen percentage; and (d) the quantity of manure prepared from human excreta and urine by Wardha System.

Sample surveys

Since there are no satisfactory data available to show the present position of manure production in villages under the above heads, basic data should first be obtained through sample surveys carried out on a statistical basis before the programme is launched, and the progress achieved from year to year should be verified by means of similar random surveys carried out on the same basis. Prizes may be awarded to the villages showing the best performances in each unit of five or ten villages. Probably, the best test of increased manure production would be to require all the competing villages to hand over to the Government proportionate quantities of food grains or other products that may be grown under the above programme.

Other materials for composting

While the above remarks and the methods of composting with special reference to sectional filling of trenches and methods of urine conservation apply in general to all villages, there are however special areas where compost could be prepared from special types of refuse material available locally, e.g. water-hyacinth, sugarcane trash, forest litter, *jowar* or cotton stubbles, etc. Such areas however are quite limited, except in the case of water-hyacinth which has spread over vast areas of Bengal. In the above case, the compost is best prepared on the spots where the refuse exists. For example, water-hyacinth compost has been prepared on a large scale on the banks of ponds, canals and streams by taking the hyacinth to the banks and spreading it in layers of 1 in. thickness sprinkled over with canal or bank mud, allowing the material to partially dry for a day or two and building the heap to a height of 4 or 5 ft. After the material has dried down to about half the initial moisture content, the heap is plastered over with earth and allowed to mature for a period of two to three months, after which it is ready for application to land.

Sugarcane trash is best composted in the fields by scraping out shallow trenches parallel to the irrigation channels to a depth of 2 to 2½ ft. so as to be just above the water-seepage level. Layers of one foot thickness of trash are placed in the trench and sprinkled over with cow-dung emulsion or refuse. The heap is built up to a height of 2 to 3 ft. above ground level and the top is covered over with earth to minimize losses by evaporation. Under these conditions, it is found that the seepage water from the irrigation channel keeps the whole mass quite moist and rapid decomposition takes place. At the end of three months, the mass is taken out of the trench and formed into a heap on the ground and sprinkled over with earth. The second stage of decomposition now sets in and the manure is ready in another month or two for application to land. A large amount of compost from sugarcane trash has been prepared in Bombay Province by adopting the above method.

Compost from forest leaves has been prepared on a large scale in Bombay Province. The method of composting is somewhat similar to that of sugarcane trash, except in this case, water is more difficult to obtain than on sugarcane farms. It is therefore advisable to collect the leaves and litter just before monsoon time and dump them into pits dug in the forest area, having a depth of 3 ft. and suitable breadth and length, depending on the quantity of refuse available. Alternate layers of refuse one foot thick are sprinkled over with a layer of earth one to two inches thick. The heap is allowed to rise to a height of 2 to 3 ft. above ground level and the top is made concave or flat or convex depending on the increasing quantity of rainfall in that area. After monsoon has set in and the heaps are fully moistened from top to bottom, the top should be made dome-shaped in all cases and sprinkled over with earth, in order to prevent passage of excessive rain into the heap. The manure is generally ready in about three months' time after the close of the monsoon, but if it is desired to shorten the above period, the mass can be taken out of the pit and formed into a heap overground after the monsoon period and covered with earth, when it undergoes fresh heating and gets ready within a month's time. The composting of forest leaves is best done as a cooperative endeavour of a group of villagers living in the adjoining villages, sharing jointly the labour involved in collecting the refuse from the forest area, preparing the compost and transporting the same to their villages.

WEEDS MAY BECOME ASSETS

AGRICULTURISTS in Australia believe that at least three weed pests can be turned into profitable crops.

There is a strong possibility that the saffron thistle (*Carthamus lanatus*) which is on the Australian list of prohibited noxious weeds will be cultivated as a crop. The seed has good oil properties and is valuable as turkey feed. One firm of oil and fodder cake manufacturers is buying seed at 6 pence a pound.

Last year when harvesting experiments were carried out with saffron thistle, it was found that the crop could be reaped with a normal harvester provided that every alternate tooth was removed from the comb. The seed is larger than wheat grain and must be harvested before absolutely ripe or the oil content deteriorates.

Samples of another weed, *Sida rhombifolia* or common sida, are being sent to England to discover whether the plant can be used in place of Indian jute for making hessian and sacking. Experts believe that the fibrous nature of the plant should make it suitable for sack-making.

Experiments with the seed of wild turnip (*Brassica tournefortii*) for the extraction of oil promise a use for this weed, now considered a menace by wheat-growers.

A South Australian miller who is already exporting large quantities of mustard seed oil to India and south-east Asia claims that he has produced equally good oil from wild turnip seed. The oil has the same purity (98 per cent), tastes sweeter, has clearer colour and will not go rancid. It can be used for culinary purposes and as a base for perfume and cosmetics, while the residue makes good laying mashes for poultry farmers.—*Australian Agricultural Newsletter*, No. AGN /227.

USE OF SULPHATE OF AMMONIA AS FERTILIZER WITH SPECIAL REFERENCE TO SIND

By M. A. IDNANI

SULPHATE of ammonia is one of the most promising of the artificial fertilizers available to the cultivator for improving crop yields and is finding increasingly useful application in Indian agriculture on a variety of crops. The response obtained by its application is both quick and certain and increased yields ranging from 25 to 100 per cent and over have been reported. In systematic field trials conducted at the Agricultural Research Stations in Sind, the effect of application of the fertilizer on all the major crops of Sind was generally significant. The following Table illustrates the extent of increased yields obtained in some of these trials.

TABLE I

Results obtained from application of sulphate of ammonia

Treatment	Crop	Yields in pounds	Percentage increase over control
Ammonium sulphate	Wheat	1728	26
	Rice	2296	37
	Cotton	1194	38
Compost	Wheat	1312	3
	Cotton	902	4
Compost+Ammonium sulphate	Wheat	1807	32
	Cotton	1180	36

It will be observed that under Sind conditions bulky organic manures like compost, applied alone, give a poor response and the increase in yield is generally not significant. On the other hand the beneficial effect of application of sulphate of ammonia is reflected in a marked improvement of crop growth, resulting in a substantial increase in yield which would leave a fair margin of profit to the cultivator.

Nitrogen deficiency

The average yields of crops obtained in India are perhaps the lowest in the world. One of the most important factors responsible for this is the general poverty of nitrogen in our soils. The total content of this essential plant food constituent in Indian soils is usually below 0·05 per cent of which the major part is in complex organic combination and not easily available to the crop. The response obtained by the application of only 100 to 200 lb. of sulphate of ammonia per acre shows that the addition of an available form of nitrogen to the extent of 0·001 to 0·002 per cent of the soil can effectively make good this deficiency and improve yields.

It is thus obvious that judicious manuring of crops with available forms of nitrogen must be given an important place in our soil management practices and in this respect application of sulphate of ammonia demands a serious consideration from our cultivators.

Action on soil

While the use of this fertilizer has considerably extended in recent times, there is a certain amount of misgiving with regard to the consequences of its indiscriminate and continuous application, particularly on the physical properties of the soil. Sulphate of ammonia is an acid fertilizer and after the absorption of its nitrogen content by the plant leaves a residue of acid in the soil, which in presence of lime is neutralized forming calcium sulphate. Theoretically a 100 lb. dose of sulphate of ammonia per acre would produce sufficient acids to require 150 lb. of soil lime for neutralization. Actually the net loss of calcium observed under

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field conditions is between 100 to 200 lb.[1]

In the absence of any free reserves of calcium carbonate in the soil, the neutralization of acids takes place at the expense of exchangeable calcium in the clay complex, until after serious loss of the base, the soil becomes acidic, the texture deteriorates and there is a general loss of the favourable conditions for plant growth associated with sufficiency of lime.

Experiments at Woburn and Broadbalk

The effect of continuous application of sulphate of ammonia on lime-deficient soils on the one hand and lime-rich soils on the other, is well-illustrated by the experimental plots at Woburn and Broadbalk. The Woburn soils originally contained only 0·31 per cent lime. After 20 years' continuous use of the fertilizer, the yields began to decline and later it became impossible to grow wheat or barley any longer[2]. Analysis of the soil at this stage showed that there were still sufficient quantities of water, soluble calcium, nitrogen, phosphoric acid and potash in the soils for the requirements of the crop. The cause of infertility probably lay in the development of high acidity and loss of exchangeable calcium caused by the application of the fertilizer over a long period (Table II).

TABLE II

Exchangeable lime in parts per million of soil

Treatment	Woburn soils	Broadbalk soils
No manure	1372 (*p*H 5·7)	3800
Sulphate of ammonia	224 (*p*H 4·5)	3810

The Broadbalk field experiments provide example of the protection against the deleterious after-effects of the fertilizer afforded by soils which contain some natural reserves of lime. Under such conditions, the clay complex of the soil remains stable and the loss of calcium falls preferentially on the free calcium carbonate present. The Broadbalk fields had a lime content of about 4·0 per cent. In spite of 80 years continuous application of the fertilizer at the rate of 200 lb. per acre, the exchangeable calcium was not affected (Table II) and no deleterious effects on soil or crop were observed.

The position in Sind

The alluvial soils of Sind contain large reserves of free calcium carbonate to the extent of about 10 per cent of the soil. The total quantity of lime at this rate works out to about 3,00,000 lb. per acre in the surface 9-inch layer of the soil. Assuming a loss of 120 lb. of calcium carbonate for each dose of 100 lb. of sulphate of ammonia, there would appear to be enough of the base present to protect the soils for about 2,500 years.

With the presence of such large reserves of free lime, the discriminate use of this fertilizer offers a very fruitful scope for increasing crop yields and in order to assess its limitations, a study of some of the important factors affected by its application has been made.

Experiments

Laboratory experiments of the solubilization of calcium by sulphate of ammonia were carried out on a sample of Sind soil containing 11·0 per cent calcium carbonate. Doses of the fertilizer corresponding to 100 lb., 500 lb. and 3,000 lb. per acre were mixed with the soil and moisture was kept constant at 18 per cent. The soils were kept in flasks at room temperature for five weeks after which samples were analyzed for water-soluble calcium, total calcium, *p*H and nitrate nitrogen. The results are given in Table III.

TABLE III

Treatment	Water soluble $CaCO_3$ mgm.	$CaCO_3$ neutralized by S/A	Total $CaCO_3$	*p*H	N-added as S/A mgm.	NO_3-N formed mgm.
Soil alone (100 gm.)	151·75	..	11·0	8·2	..	1·57
Soil+5 mgm. S/A	157·50	5·75	11·0	8·2	1	3·35
Soil+25 mgm. S/A	172·50	20·75	10·8	8·2	5	6·45
Soil+150 mgm. S/A	315·75	164·00	10·9	8·2	30	33·90

The results obtained show that in the presence of free calcium-carbonate, the *p*H of the soil was not affected even by the highest dose of the fertilizer applied at the rate of 3,000 lb. per acre. Nitrogen of the added sulphate of ammonia was more or less quantitatively converted into nitrates in the course of five weeks showing that the reactions of the fertilizer in the soil had reached completion. Water soluble calcium increased with the dose of fertilizer applied but the total quantity of calcium was the same as in the beginning since the soluble calcium salts formed remained in the body of soil under the conditions of the experiment. This would more or less be the case under field conditions in Sind where the total rainfall per annum is only about 5 in. and there is no possibility of loss of calcium salts by leaching in drainage waters.

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[1] Russel, E. J. (1926). Soil conditions and plant growth.

[2] Mann, H. H. and Barnes, T. W. Studies of soil after 50 years of wheat or barley cropping on soil made acid with sulphate of ammonia.

The conversion of calcium carbonate into soluble forms works out to 115 lb. for 100 lb. of the fertilizer used. The total quantity of 3,30,000 lb. of the base in the surface 9-inch layer of the soil would thus require about 2,870 applications to be completely neutralized. Until that stage is reached, no harmful effects either on the soil or crop would become manifest. Even on the Woburn soils with a lime content of only 0·31 per cent crop yields remained normal for nearly 20 successive years of application of the fertilizer.

Nevertheless the use of sulphate of ammonia involves the conversion of basic calcium carbonate into neutral calcium sulphate and nitrate and after the complete neutralization of the base, the soil would eventually become acidic with all its consequences. Experiments on the Woburn soils however show that the infertility of such soils is not due solely to the loss of calcium from the soil. Their toxicity to plant growth is attributed to the injurious action of high acidity in the soil and the presence of soluble aluminium under these conditions. Mann and Barnes working on the methods of correcting such deteriorated soils found that the addition of neutral calcium salts and thereby increasing water soluble calcium in the soil, did not bring about any improvement but crop growth was restored to normal only when calcium was applied in the form of basic calcium carbonate, which neutralized the acidity and rendered toxic aluminium insoluble. Highly successful results were also obtained by the application of organic matter alone in the form of farmyard manure at the rate of 10 to 20 tons per acre, which seemed to counteract all the toxic conditions of the soil and give normal and healthy crop growth where only pathological plants grew before. ‘Whether the effect of farmyard manure was due to any particular constituent or to a buffering action which prevented the acidity from having its full effect is not yet clear but it is evident that the correction of toxicity due to acidity in soils is a new use for the coarser organic manures of which farmyard manure may be taken as a type’.

These important results indicate the lines along which dressings of sulphate of ammonia may be judiciously combined whenever the fertilizer is used on any type of soil.

Discussion

The alluvial soils of Sind contain adequate natural lime reserves to protect the soils for a long time to come but even the slow deterioration from single applications of the fertilizer can be effectively checked by applying a basic dose of farmyard manure. Under Sind conditions, nitrogen applied as a 50 : 50 mixture of compost and sulphate of ammonia has given greater economic returns than when the fertilizer is used alone. It is also known that the quality of seed obtained by the use of organic manures is better than when artificials alone are used. On all accounts therefore it would be a sounder long-term policy to include the use of bulky organic manures in our fertilizer practices. The deficiencies of either, when used singly, are made good in the combination to the benefit of the crop.

Conclusion

Sind affords very favourable conditions for the extensive use of sulphate of ammonia as a fertilizer and no deleterious after-effects of its application may be feared, specially if it is used in combination with organic manures. The high efficiency of its nitrogen content as plant food gives an assured response and greater economic returns than other manures. Sulphate of ammonia has the advantages of being a neat and concentrated manure which make its transport and use easy and cheaper. The proposed manufacture of the fertilizer in India would provide to the cultivator one of the most effective means for increasing crop yields in India and would augur well for the future of agriculture, specially in Sind.

SOME OBSERVATIONS ON THE PERFORMANCE OF SEED FROM RUST-AFFECTED WHEAT PLANTS

By R. S. VASUDEVA and K. M. DUTT

IN 1947 the outbreak of wheat rust epidemic in the Central Provinces, Central India Agency States, Bombay and Hyderabad resulted in considerable destruction of the crop. During the present world shortage of food, this epidemic caused great alarm and it was doubtful whether the produce from the affected area would even meet the needs of seed requirements. As a result of the attack of rust, the grain is invariably underdeveloped and shrivelled. Doubt arose whether such imperfectly formed grain would be suitable for sowing purposes. It was, therefore, considered necessary to investigate the vitality of such seeds.

Germination tests

Accordingly, tests were undertaken to determine whether the crop raised from such seeds would at all be profitable. With this end in view, 69 samples of wheat seed from rust-affected crops were received in July-August 1947. The germination tests of these samples showed them to be good enough for seed purposes in the coming season, i.e. October 1947 since the percentage of germination ranged from 46 to 99.

Of 68 samples of wheat seed of rust-affected crop from Bombay Province, 44 samples gave a germination percentage of 70 to 99 and were quite suitable for seed purposes. From the two lots of 36 and 40 samples received from various parts of Central Provinces, Central India and other States of Central India, 18 samples were rejected, 26 samples could not be tested due to the attack of insects while the percentage germination of the remaining 32 samples ranged between 70 and 98.

Samples of rust-affected seed were divided into six lots and from each lot fifty seeds were taken at random and kept for germination study in moist chambers. The samples showing germination below 70 per cent were not recommended for seed purposes.

In another test, it was found that Agrosan GN did not appreciably affect the percentage of germination but delayed it.

Performance of seed

Germination : The performance of seed raised from healthy and rust-affected plants was studied in detail with three varieties, i.e. N.W.R.28, I.P.52 and I.P.111 whose germination was compared in the laboratory and in the field. The results of such tests are given in Table I.

TABLE I

Per cent germination of seed from healthy and rust-affected plants

Variety	Seed from plants	Laboratory		Field	
		No. of seeds sown	Percentage	No. of seeds sown	Per cent
N.W.R. 28	Healthy	300	98	400	97·5
	Rust-affected	300	90	400	83·2
I.P. 52	Healthy	300	99	400	95·7
	Rust-affected	300	79·6	400	75·7
I.P. 111	Healthy	300	98	400	98·2
	Rust-affected	300	63	400	50

Growth : Seed samples of these three varieties both from healthy and rust-affected plants were planted side by side in a plot in the Mycological Division of the Institute. Fifty plants of each variety were selected at random and staked with a view to study the relative growth rate. The first records regarding the growth were taken when the plants were 38 days old and subsequent observations were

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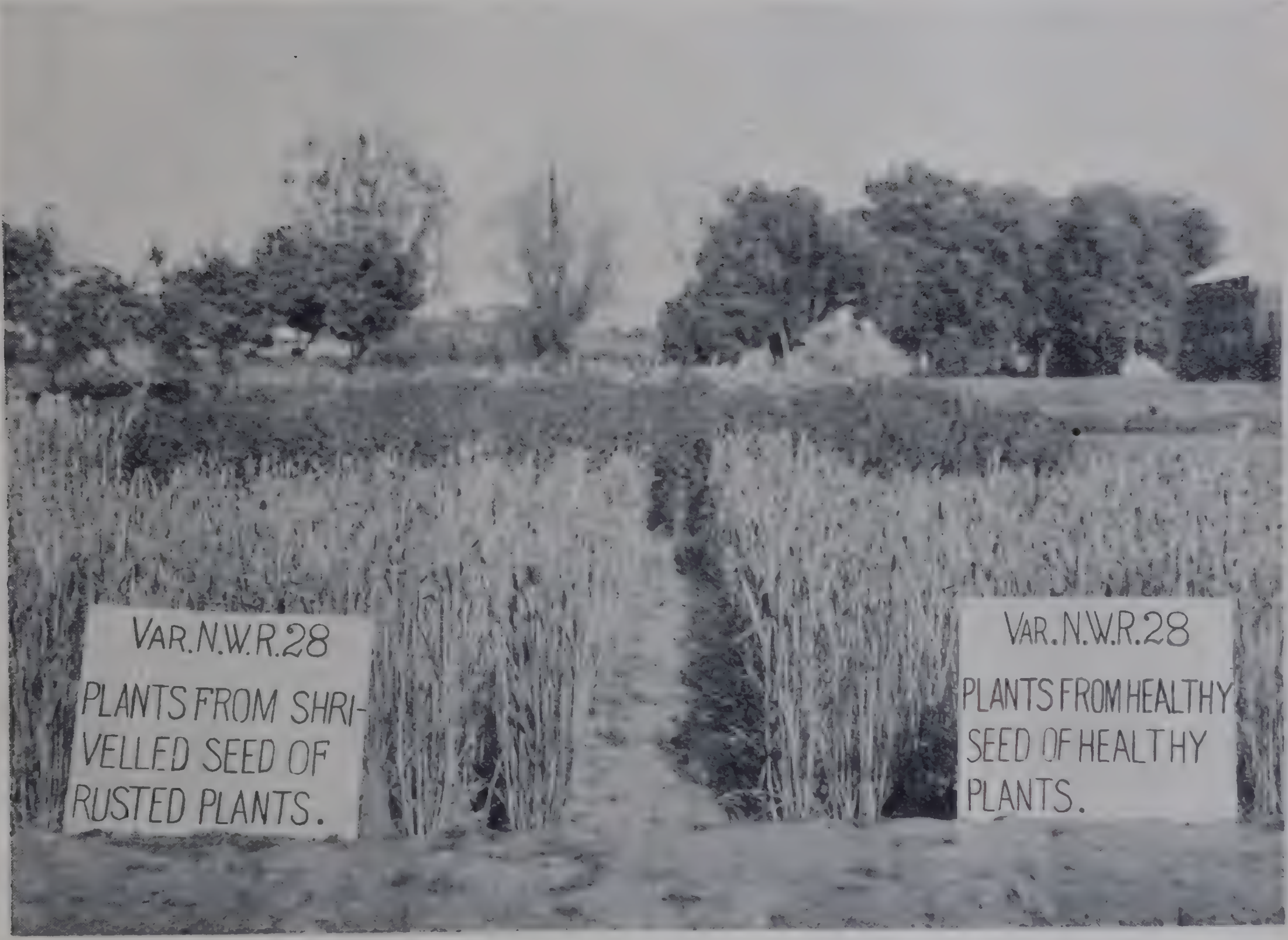
VAR. N.W.R. 28
PLANTS FROM SHRI-VELLED SEED OF RUSTED PLANTS.
VAR. N.W.R. 28
PLANTS FROM HEALTHY SEED OF HEALTHY PLANTS.

FIG. 1. Performance of seed from rust-affected and healthy wheat plants.

made every fortnight. The number of tillers was also recorded. The average height and number of tillers of 50 plants in the three varieties are recorded in Table II.

TABLE II

Average height (cm.) and number of tillers of plants raised from healthy and rust–affected plant seed

Varieties	No. of days	38		52		66		80		94	
		H	T	H	T	H	T	H	T	H	T
N.W.R. 28	Healthy	18·5	2·8	26·2	—	36·1	6·0	53·1	6·6	67·5	6·6
	Rust–affected	15·5	2·2	22·9	—	32·7	5·8	49·4	6·3	68·2	6·7
I.P. 52	Healthy	13·7	3·1	21·0	—	30·8	8·2	50·5	8·8	84·1	8·4
	Rust–affected	15·6	2·7	23·4	—	35·2	6·7	59·0	8·3	87·1	8·4
I.P. 111	Healthy	20·6	3·0	30·9	—	48·2	6·8	72·3	8·2	92·0	8·2
	Rust–affected	15·6	2·0	24·2	—	39·0	7·8	66·1	12·1	91·9	12·1
H=Height	T=Tillers										

It was observed that the plants raised from healthy seed of N.W.R.28 and I.P.111 exhibited higher growth rate for the first 80 days which was later made up by the plants raised from rust-affected plant seed. In the case of variety I.P.52, it was indicated that the plants raised from rust-affected plant seed exhibited higher growth rate for the first 94 days but later on this difference was made up. The plot in which the shrivelled seed from rust-affected plants of variety I.P.52 was planted, was only about 3½ feet from the water channel and it appears that this might have accelerated the growth rate of this sample.

Tillering in varieties N.W.R.28 and I.P.52 was slightly more vigorous in the plants raised from healthy plant seed for the first 80 days but later practically no difference was observed in the plants raised from healthy and rust-affected plant grains. It was, however, observed that the average number of tillers in I.P.111 during the later period of growth was greater in plants raised from rust-affected plant seed. This is probably due to the poor germination of this sample, i.e. 50 per cent as against 98·2 per cent in plants raised from healthy plant seed, and that the individual plant had greater unit area for growth and spread.

Yield: The average number of ears and the average weight of grains per plant is recorded in Table III.

TABLE III

Average number of ears and weight of grains compared

Variety	Plants raised from seed	Average number of ears	Average weight of grains (grams)
N.W.R. 28	Healthy	5·3	7·1
	Rust-affected	5·4	7·5
I.P. 52	Healthy	6·7	8·2
	Rust-affected	6·5	8·3
I.P. 111	Healthy	5·9	7·7
	Rust-affected	9·6	13·8

There appears to be no differences in the number of ears and weight of grains per plant in the crop raised from healthy and rust-affected plant seed in varieties N.W.R. 28 and I.P. 52, but in variety I.P. 111 the number of ears as well as weight of grains obtained from plants raised from rust-affected plant seed is greater on account of better tillering which has been explained on basis of smaller number of plants per unit area.

Absolute weight of grains raised from healthy plants and from plants raised from rust-affected plant seed was determined by weighing 1,000 grains taken at random. Weight of these grains is compared with the weight of healthy plant grains and rust-affected plant grains, part of which had been planted in the experimental plots for these observations.

The density of the grains was also determined and the data are summarized in Table IV.

TABLE IV

Absolute weight and density of grains of seed planted and raised from healthy and rust-affected plant grains

Variety	Seed from plants	Absolute weight		Density	
		Seed planted	Seed raised	Seed planted	Seed raised
N.W.R. 28	Healthy	32·10	35·68	1·31	1·35
	Rust-affected	27·30	35·74	1·27	1·33
I.P. 52	Healthy	27·85	34·52	1·34	1·37
	Rust-affected	15·36	34·80	·12	1·31
I.P. 111	Healthy	29·75	39·31	1·28	1·32
	Rust-affected	18·36	39·97	·13	1·34

The data show that the absolute weight of seed of all the varieties planted is much lower in the case of rust-affected plant grains. Also the density of seed from affected plants tends to be lower probably due to severity of infection. The differences in variety N.W.R. 28 are not marked as the seeds from affected plants were not so shrivelled as in the case of other varieties.

No appreciable differences were observed in the absolute weight and density of grains raised from healthy and rust-affected plant seed.

The yield of grains raised from healthy seed and rust-affected seed in the case of N.W.R. 28, I.P. 52 and I.P. 111 was 3·93, 4·26, 3·93 and 3·28, 3·6 and 2·62 oz. per square yard respectively.

The difference in percentage germination of healthy and rust-affected seed of the three varieties in the order stated above was 14, 20 and 45. Obviously, if the number of seed per unit area is increased with a view to obtain as good a stand as in the case of healthy seed crop, a yield which favourably compares can be obtained from the crop raised from rust-affected plant seed. The stand of crop raised from healthy plant seed and from rust-affected plant seed is shown in Fig. 1.

The results in general are in accordance with those obtained by Luthra and Chima* with plump and shrivelled grains due to hot dry winds.

Acknowledgment

These experiments were undertaken at the instance of Dr. J. N. Mukherjee, Director of the Institute. The germination tests of seed samples reported in the first two paragraphs of this article were conducted by Dr. J. F. Dastur and Dr. R. D. Asana assisted by the junior author to whom our thanks are due.

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* Luthra, J. C. and Chima, I. S. (1941). Some studies on the potentiality of shrivelled wheat grains. *Pros. Ind. Acad. Sci.*, **14**, 47-67.

THE BHIMA VALLEY

By N. G. APTE

BOMBAY Province, or for the matter of that, Southern India is full of valleys, which divide the country into several regions, each having an economy of its own. A detailed idea of one such valley and the amount of development that could be expected out of the same, so far as regional self-sufficiency is concerned, is given in this article.

The Bhima Valley is a region which could be considered to help to a great extent the province of Bombay in the matter of supply of foodstuffs.

A glance at the map will show that this Valley runs through Poona and Sholapur Districts and part of Bijapur District. This also covers certain part of Ahmednagar District and a very small part of Satara District. Akalkot, Phaltan, Bhor and Jath are the four States which are included in this Valley. The total area of this Valley is about 27,000 sq. miles. The rain falling over all this area is drained through the course of the river Bhima. The total length of this river from its source up to Raichur where it meets the river Krishna in H.E.H. the Nizam's Dominions, is about 450 miles. A number of streams join it, out of which fifteen are important with a total length of about 1,500 miles.

The average breadth of this Valley is about 90 miles and the straight length of the Valley is about 300 miles. This length extends from west to east making a square area of 27,000 sq. miles.

The rainfall decreases towards the east up to the first 200 miles but increases slowly as we proceed further. There are, therefore, several rainfall zones in this length of 300 miles. In the first 25 miles the rainfall varies between 125 to 75 in. annually. In the next 10 miles there is a sudden fall and it ranges near about 50 in. When we come to Poona, which is at a distance of about 40 miles, the average comes to about 30 in. This continues for another 10 miles and at a distance of about 50 miles from the western end of the Valley the rainfall is less than 25 in. This feature continues up to 200 miles and then the rainfall begins to increase and goes up to 30 or 35 in. for a distance up to Raichur. The temperature and humidity which count for evaporation follow the same lines, i.e. the temperature is low in high rainfall zone and goes on increasing towards the east. Humidity is highest in high rainfall and lowest in low rainfall zones.

Taking into account the very high rainfall along the Sanhyadri or Western Ghats, it will be evident that very enormous quantities of rain are drained through the course of this river and if by some means this huge quantity of water is utilized for crop production, it may irrigate a very enormous area under food grains. The food grain crops require about 500 lb. of water to produce 1 lb. of dry matter. Since the ratio of grain to fodder is 2 to 5, i.e. every seven pounds of dry matter would give two pounds of grain, 1½ tons of water would give roughly two pounds of grain. This means that three-fourth of a ton of water would yield one pound of food grains on the average. If the total quantity of rainfall is looked at from this point of view, it may be clear as to how much quantity of grain could be produced by the quantity of water that is drained through the Valley.

The total area over which this very heavy rainfall precipitates is about 4,000 sq. miles in extent. Taking the average as 75 in. and calculating on the basis of the weight of water per acre (1 acre inch weighs 100 tons roughly) 75 acre inches would weigh 7,500 tons. One mile is equal to 640 acres. One square mile therefore would have 4,800,000 tons of water and 4,000 sq. miles, 19,200,000,000 tons or 1,920 crores of tons of water. Taking roughly, about 2,000 crores of tons of water would be falling on this area in this Valley. Calculating on the basis of three-fourth of a ton of water per pound of food grains, 2,560 or 2,500 crores of pounds of food grains would be produced by this quantity of water. Calculating at the rate of 500 lb. per head per year, this quantity of food grains will suffice for about 5 crores or 50 million heads of population. The population

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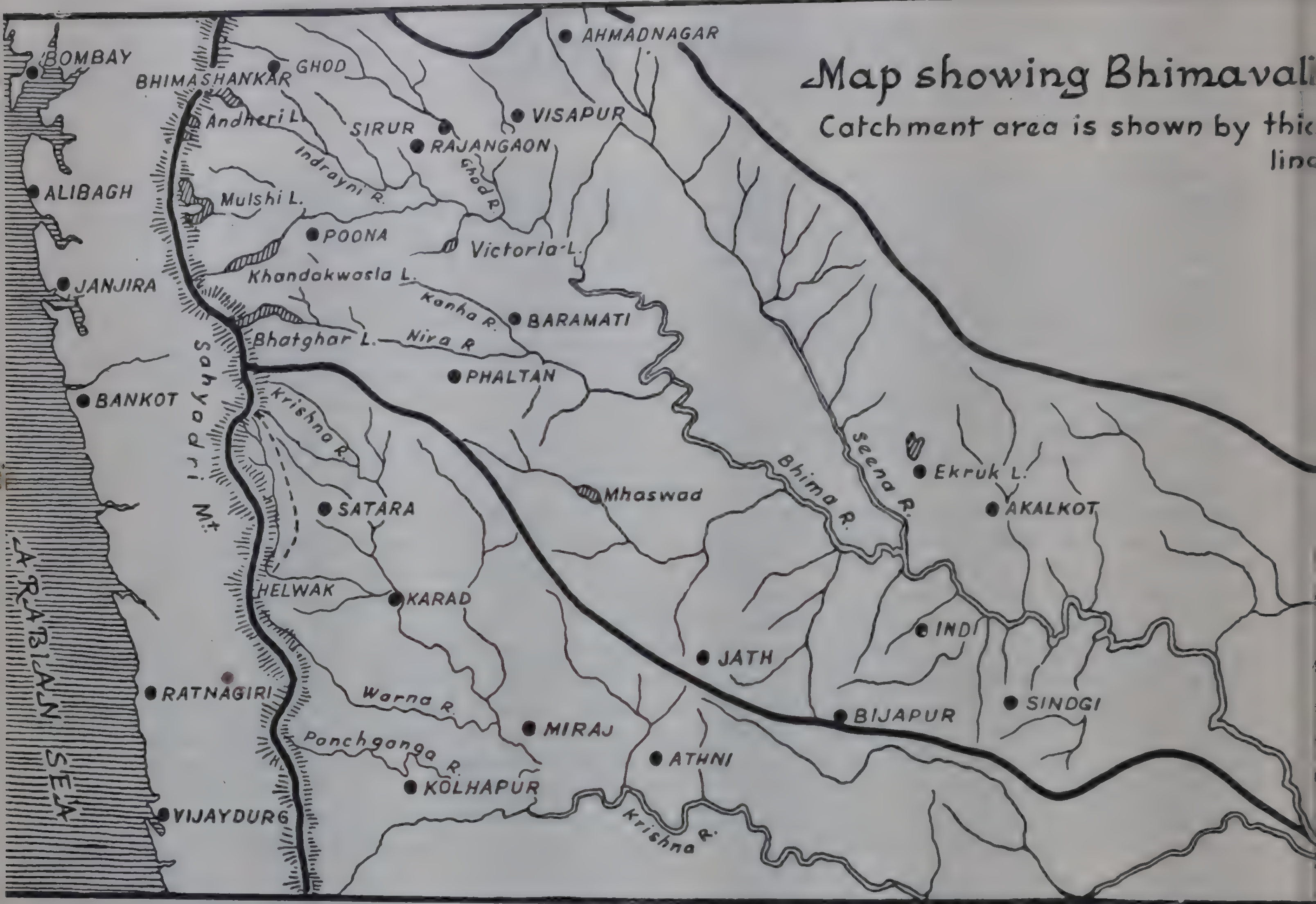
Map showing Bhimavali
Catchment area is shown by thic
lin
BOMBAY
BHIMASHANKAR
GHOD
AHMADNAGAR
Andheri L.
SIRUR
VISAPUR
RAJANGAON
Indrayni R.
Ghod R.
ALIBAGH
Mulshi L.
POONA
Victoria L.
JANJIRA
Khandakwasla L.
Kanha R.
BARAMATI
Bhatghar L.
Nira R.
Sahyadri Mt.
PHALTAN
BANKOT
Krishna R.
Seena R.
Bhima R.
Ekruk L.
AKALKOT
Mhaswad
SATARA
ARABIAN SEA
HELWAK
KARAD
INDI
JATH
RATNAGIRI
BIJAPUR
SINDGI
Warna R.
MIRAJ
Panchganga R.
ATHNI
KOLHAPUR
VIJAYDURG
Krishna R.

of Bombay Province inclusive of States is only about 25 million. It will thus be evident that in one Valley only there is enough amount of water to produce the required quantity of food for the province *provided it is possible to make every drop of this water available for crop production.*

A mention of the climatic conditions during the period of precipitation has to be made. The precipitation is during the period of June to September and except for a few days the atmosphere is sufficiently humid. It may be mentioned that the loss due to evaporation during the precipitation is negligible. Another factor for consideration is that of absorption by the soil and sub-soil. In this area of 40 miles the gradiant is very steep and the sub-soil hard; absorption, therefore, is very small and may amount to a few inches only. Even this low absorption would be useful for crop production in lower areas and therefore it should not be excluded from consideration in calculating crop production.

The calculation on the basis of natural conditions shows that this one Valley is capable of supplying a quantity of water enough to produce food for about 50 million population. In case the proposed plan for small bunds is taken up and the water is made available for production it would go a long way towards making the region self-sufficient and providing food crops to other deficit areas. A part of this work can be taken up immediately in the ensuing months. This would ensure the *rabi* crops in the famine zone of the Bombay Province at least over an area of about 200 miles along the length of this river. This would irrigate about 2,500 acres per mile length, amounting roughly to 5,00,000 or ½ million acres along the course of the main drain only. When this project has been worked to its full capacity, at least six times or 3 million acres could be irrigated for crop production, yielding a crop of about 2·25 million tons of food grains and feeding a population of about 10 million heads. From this it will be clear that it will be possible to impound only half the quantity of water that falls on the Sanhyadri and irrigate only one-sixth of the total area of this Valley. Other means will have to be devised to utilize the remaining 50 per cent of the available water supply.

A topographical description would not be out of place at this stage as that would give a clear idea of its utility. The Valley is situated at a height of about 4,300 ft. There is a fall of about 1,500 ft. in height within the first 20 miles of the Valley. Then in the next ten or fifteen miles, the height falls by another 500 to 700 ft. and near about Poona the general height is about 2,000 ft. Thus within the first 40 miles the gradiant is very steep and there is less scope for absorption underground. The sub-soil as well as the soil in this area is also not very suitable for absorption. The soil is light and about 6 to 9 in. deep with a hard and, in many cases, impervious substratum. The soil cover is reduced in some places to about 3 in. or less with the result that bare rock is exposed. This will clearly show that the seepage underground, if any, may be only a few inches and most of the water falling in this area is drained through the rivers or other drains.

In the next 250 miles of the Valley, the height falls to about 1,100 ft. from 2,000 ft. From this height a stretch of the Valley 150 miles long falls by 600 ft. giving a gradiant of about 4 ft. to the mile. This is so from Poona to Sholapur. The length of the river itself however is much greater as the river has many curves. In this area the soils are deep and in many places the depth goes up to 5 to 6 ft. The porocity or vacant space in the volume of the soil is within 50 to 60 per cent. These soils, therefore, absorb most of the rain that falls over them, and are useful for crop production. If this rain water is supplemented by the water flowing through the central drain (or river) fruitful results will accrue.

The gradiant in the first 40 miles affords scope for the construction of big dams as a part of long range projects. Already the bigger dams, e.g. Mulshi Bhatgar, Khadakwasala are situated in this Valley. There are more situations which could be selected and bunded. In this area as well as in the adjoining one small bunds could be constructed to develop agriculture on the banks of the small streams that drain small areas.

An important project can be undertaken on the central drain of the river Bhima. The region which can be utilized for setting up bunds in the first instance is about 250 miles long. The bed of the river is about 25 to 30 ft. deep from the general level of the land. This naturally gives scope for bunds of equal heights. If such bunds could be set up at every three miles and water impounded in these, the available quantity of water would be useful for the production of one crop over about half million acres. The scheme presupposes the use of oil engines and pumps or electric power pumps for pumping out water.

A study of actual pumping work showed that as much as 300 acres are brought under irrigation by one pumping set of a 30 h.p. engine and a 8 in. pump.

The project if taken up would not only reduce the shortage of food but will also increase the underground water in the lower areas.

What the Scientists are doing

RESEARCH ON *DAHI*

IT is well-known that flavour of *dahi* varies in different parts of the country. While some areas are famous for their 'good quality *dahi*,' others produce very inferior type of *dahi*. The difference in quality is more perceptible to the people going from 'good' *dahi*-producing area to an area producing *dahi* of inferior quality. The aroma and flavour of *dahi* largely depend on the bacteria that are used in making it. A scheme has been worked by the Indian Council of Agricultural Research at the Indian Dairy Research Institute, Bangalore, to gather information on the composition, flavour, aroma, body and texture of *dahi* in various parts of the country and to study the type of bacteria used in the making of *dahi* in all areas, particularly those ones, which are famous for *dahi*. The object is to find out the part played by different types of bacteria in the formation of good *dahi*.

In all 1,000 samples of *dahi* secured from dairies, *halwais*, street vendors, and private houses from selceted urban and rural areas, have been examined covering the three seasons of the year. The physical property, acidity of the samples and the nature of microflora as revealed by microscopic appearance, were examined at the collection centre while observations on the total bacterial count, the fat, protein and ash contents of the samples were made at the main collection centre or at Bangalore.

Dahi from North India showed firm curd formation and was sweet to mildly sour in taste with an agreeable flavour. During summer and monsoon there were greater number of samples which were sour and were associated with gas formation and other defects. In regard to acidity and chemical composition the samples showed very wide variation irrespective of the source and season. Amongst the bacteria isolated there were 209 streptococci and 430 lactobacilli, which were examined for study of their morphological, cultural, and bio-chemical characteristics. Most of the samples from North India showed either a preponderance of streptococci or a balanced proportion of streptococci and lactobacilli in all seasons. Yeasts were also present in many of them but they were more numerous during monsoon. Almost all South Indian samples, whether collected in summer or in winter, showed preponderance of lactobacilli as well as yeasts; streptococci were present only in a few of them. Some moulds were also found to be present in some of the samples collected in Gujerat, Nagpur and Bombay areas.

The difference between North Indian and South Indian *dahi* is also attributed to the better quality of milk and organized methods of production adopted in Northern India.

It was also observed that earthenware vessels were better than metal ones from the point of view of flavour production due to the greater scope for aeration provided in the former. Scrupulous cleaning of the pots was essential in order to eliminate contaminating organisms which would spoil the curd. In the case of metallic vessels slight off-flavour was noticed occasionally. A shallow type of vessel helped in obtaining better flavour than a narrow one, particularly when kept covered with a lid. In the latter case, vigorous shaking of the curd for 10 minutes at a uniform rate and then keeping it for some time resulted in improving the flavour considerably.

During cold weather by pre-incubating the inoculated milk at 37 to 40° C. for one or two hours, and then holding at a low temperature of 20 to 22° C., it was possible to obtain good curd associated with pleasant flavour.

The effect of adding citric acid salts, sugars and starch on the quality of *dahi* has been investigated. The addition of ·02 per cent of sodium citrate or its equivalent amount of citric acid to milk to be converted into *dahi* improved the flavour of *dahi* considerably. Flavour is also improved by addition of 1 to 1·5 per cent of lemon juice. The addition of sugars particularly sucrose imparted a sweet taste, but the concentration of sucrose greater than 5 per cent made the product very sweet.

As a result of this work, some suitable starters for making *dahi* have been evolved, which will help many a people in the *dahi* trade to produce good *dahi*. For the time being the starters are available in liquid condition but steps are under consideration by which it will be possible to dessicate the starters. This will prolong the life of the starter and facilitate transport over long distances. (H.K.L.)

PRIZE FOR GROUNDNUT HAND DECORTICATOR

A PRIZE of Rs. 2,000 will be awarded by the Indian Oilseeds Committee to any person or body who designs the best model of groundnut hand decorticator and demonstrates its working to the satisfaction of the Indian Oilseeds Committee or a competent body to be appointed by it. Entries accompanied with diagrams showing details of the machine should be submitted to the Secretary, Indian Oilseeds Committee, Ministry of Agriculture, New Delhi, so as to reach him not later than October 31, 1949. Competitors should be prepared to demonstrate the working of the machine at such place and time as directed by the Committee.

The groundnut hand decorticator should fulfil the following conditions:

(i) The hand decorticator should, as far as possible, be made of material easily available in the villages. It should preferably be made of wood and should have as little iron part as possible.

(ii) The construction should be simple enough so that repairs and spare parts can be provided in the villages by the village carpenter or the village blacksmith.

(iii) The grates or sieves used in the machine should be adjustable to enable proper decortication of groundnut pods of different varieties and sizes.

(iv) The turn-over and cost of decortication should compare favourably to those of power decorticators.

(v) The proportion of split and broken kernels, 'nooks' and unshelled pods in the decorticated produce should be as little as possible.

(vi) The cost of the hand decorticator should be reasonable and should not exceed Rs. 100.—(*P.I.B.*)

You ask We answer

Enquiries regarding agriculture and animal hustandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Will you please refer me to Indian institutions which might provide me with figures on production, domestic consumption, exports and imports, and wholesale prices of fertilizer during the war and post-war periods. (M. K.)

A. The production of superphosphate during war-time was in the neighbourhood of 5,000 to 7,000 tons. The present production of superphosphate is approximately 25,000 tons per annum. This is likely to be stepped up to 50,000 tons in the near future. Figures relating to the production of sulphate of ammonia are given below:

	1938–39 Metric tons	1947–48 Metric tons
Ammonium Sulphate	22,400	39,200

Since 1944, the distribution of fertilizers is controlled by the Government of India under their scheme of Nitrogenous Fertilizer Pool. The prices fixed from time to time are given below:

Sulphate of Ammonia

	Per ton f.o.r. main ports
From 1-4-44 to 31-10-44	Rs. 241
From 1-11-44 to 15-8-45	Rs. 253
From 16-8-45 to 31-5-46	Rs. 245
From 1-6-46 to 31-3-47	Rs. 230
From 1-4-47 to 3-2-48	Rs. 265
From 4-2-48 to 31-3-48	Rs. 271
From 1-4-48 to 30-9-48	Rs. 290
From 1-10-48 onwards	Rs. 294

Ammonium Phosphate

	Per ton f.o.r. main ports
From 1-4-44 to 31-12-45	Rs. 305
From 1-1-46 to 31-12-46	Rs. 255
From 1-1-47 to 3-2-48	Rs. 290
From 4-2-48 onwards	Rs. 308

Ammonium Nitrate

	Per ton f.o.r. main ports
From 1-7-46 to 31-3-47	Rs. 415
From 28-3-47 to 3-2-48	Rs. 345
From 4-2-48 onwards	Rs. 371

Di-ammonium Phosphate

From 1-4-48 ... Rs. 830 per ton f.o.r. ports
From 20-4-48 ... Rs. 872 per ton f.o.r. ports

Sodium Nitrate

	Per ton (for agricultural purposes)
From 1-4-48	Rs. 270
From 10-5-48 onwards	Rs. 290
From 1-4-48	Rs. 380 per ton (for industrial consumers)

Superphosphate

	Per ton f.o.r. main ports
Single from 1-10-47 onwards	Rs. 186
Double from 11-11-47 onwards	Rs. 495

Seventyfive per cent of the fertilizers available were consumed for food crops, the balance being utilized for such crops as sugarcane, tea, tobacco, etc. (C.S.D.S.)

What's doing in All-India

FOREST POLICY TO MEET NEW CONDITIONS

SINCE the last pronouncement of forest policy over half a century ago, there have been far-reaching constitutional, social, and economic changes in the country. India has achieved its freedom, but at the cost of partition, which apart from its political results, is bound to have far-reaching effects on the economy of the country. It is in the light of these considerations that the Government have to formulate their new forest policy.

Need for a new outlook

Some of the basic facts which must determine this are: (1) India is a land of many rivers whose economic importance cannot be overestimated; the catchment areas of many of these rivers overlap the boundaries of several political divisions; floods are of common occurrence and the heavy silt of the rivers endangers the future of high dams. It is a commonplace that the catchment areas of no river in the country is adequately protected by vegetation. (2) Agriculture as practised in India cannot prosper without the protection of and association with forests. But agriculture has encroached on forest lands or has occupied marginal lands which are better suited to forest growth. This has resulted in an ill-balanced economy with its attendant evils of erosion, shortage of fuel and manure, timber and fodder, and grazing has advanced into many regions. Generally speaking, it is true to state that while human and animal populations have increased, the necessities of life have decreased.

About three-fourths of the wood production of forests is in the form of fire-wood and charcoal. The supply of fuel and small timber to the rural population is the most important part played by Indian forests in the economics of the country. (3) Forests which are not under the control of a Forest Department are deteriorating for want of proper conservancy, including closure for regeneration. (4) In the interests of protection against soil erosion or timber production for the needs of the rural community, large areas of wastelands should be brought under forests. (5) Uncontrolled grazing has reduced the pasturage value of millions of acres. It will be necessary to effect a compromise between the conflicting interests of forest conservancy and grazing. (6) In many respects private forests are as important as those owned by the Government; owing to a lack of proper management, private forests are fast disappearing. The position is similar in many of the Indian States and a continuance of the neglect of forest management will have an adverse effect on India as a whole. (7) Erosion is known to be serious in many parts of the country, which leads to a loss of moisture in the soil and, therefore, of soil fertility. The cure for erosion is linked up with such methods as proper forest conservancy, the regulation of grazing and land utilization. (8) There is a wide gap between the supply and demand for timber and fuel in the case of both local and general consumers. (9) The post-war development of industries generally, and particularly of those using wood has increased the demands on forests. This necessitates to an increasing degree, the exploitation of many kinds of secondary timbers which were previously not exploited. The available yield of these timbers is not known, but it is certainly not unlimited. Forest management will have to ensure a sustained production of these resources. (10) One of the lessons learnt during the last war, is that timber is still one of the vital needs of a country. India cannot afford to rely too much on imports in case of an emergency, and therefore it must build up its own reserves of timber. (11) The location of India's coalfields makes it necessary in the interests of the country's economy, the highest possible production of wood fuel. (12) Centralized research has proved beneficial, but there has been insufficient liaison between forestry and the trade. A close understanding between the producer and the consumer will lead to less wastage of timber.

The policy which the Government of India laid down in 1894 was sound in principle, but it was applied on a limited scale. In the present circumstances, a forest policy of a more positive nature is needed and it must be given a far wider field of application.

The area of forests and their productivity are inadequate for the needs of the country. The essence of the future policy must be the development of a national forest estate, which will make good these deficiencies. This can be done by (a) bringing additional land under forests, whether under Government or private ownership; (b) improving the condition of the unclassed and unreserved Government forests; (c) placing private unworked forests under scientific management; (d) connecting unworked forests with roads and other lines of export; (e) improving through silvicultural practice, the yield capacity of the forests, and by replacing worthless growing stock with valuable plantations, if possible; (f) coordinating planned production or silviculture with industry; and lastly (g) developing more economic methods of timber conversion and utilization.

Afforestation of lands

At a rough estimate, about 1,40,000 sq. miles of properly managed accessible forests would probably supply the timber and firewood needs of the country. There still remains the problem of forests for protection of land and their satisfactory distribution. That leads us to the question of land utilization. It is clear that a forest policy by itself is inadequate; what is required is a land policy, the main object of which will be to derive from the soil the maximum benefits for the agricultural community in particular, and for the country as a whole in general. Such a policy is essentially a long-term one, but the need for its application is urgent. If the soil is correctly used and if the right species are grown in the right place, then the country will get all the forests it needs and the evils of erosion and short production will be eliminated. There are large tracts of country where there are few or no forests. There are eroding areas which must be afforested either in local or national interests; there are marginal and sub-marginal lands which have wrongly been brought under cultivation, and which would be more profitable under forests. All these problems have to be tackled in the light of a national policy.

Grazing and fodder

It is not possible within the compass of this article to do justice to the difficult problem of grazing; neither is it capable of solution in terms of forest policy alone. But obviously matters cannot be led to drift, since excessive or uncontrolled grazing is threatening the permanency of forests. While Forest Departments know that it is in their interests to have a contented and prosperous agricultural community along the border of their forests, there is a limit to the amount of grazing the forests can stand. The grazing policy should therefore provide (1) a grazing incidence equivalent to the carrying capacity of the forests, (2) priority for plough cattle and milch cattle and (3) grazing of essential cattle either free or at concession rates, and of non-essential cattle at commercial rates.

Fodder famines are frequent in certain regions which necessitate the import of fodder from localities with surplus fodder. These latter areas should have permanent arrangements for the export of grass.

Shifting cultivation

Shifting cultivation is a serious problem in certain provinces. This age-old custom peculiar mainly to aboriginal tribes, leads to the gradual destruction of the vegetation of the mountainous regions and ultimately to sterility of soil and erosion. Forestry is closely concerned with this problem and can help in a variety of ways, for the land subiected to this practice is essentially forest land and the people are forest dwellers. The problem is already being tackled in certain provinces, but what is required is a long-term policy, more reformatory than revolutionary in character.

Forest management

It was recognized in India long ago that the establishment of forest management on the standards of advanced countries, was essentia to progress. The result of this has been a high standard of efficiency in research and in the application of silviculture practice. Over 80 per cent of Government forests are at present under working plans, an achievement which is paralleled by only a few of the countries in Europe. The working plan sets out the objects for which the forest is to be managed or worked and prescribes for a period of years, the detailed scientific operations required to achieve these objects.

In addition to the working plans the proper foundations of a stable forest policy require expert supervision and adequate funds. The stability of forest industry and continuity of action, which is essential for the protection and maturing of timber trees, depends on the assurance of funds sufficient to carry out an accepted policy over a period of years. Forestry has suffered in the past from financial stringency. Economic crises and slumps are inevitable; but they should be regarded as episodes in economic history. In forestry unlike in agriculture where crops mature and are harvested in a year, any harm or setback resulting from severe restriction of funds is incalculable. Its results would be manifested after many years in the form of less favourable financial returns.

Central coordination

It is clear that forests are in numerous ways closely linked with the well-being of the nation as a whole. The aims and objects of forest management in all provinces, despite the diversity of local conditions are fundamentally the same. There must, therefore, be a national forest policy.

India is a rapidly developing country anxious to take her rightful place among the advanced industrial countries of the world. It is axiomatic, therefore, that production and mobilization of resources must be subject to some degree of coordination. Were there an equal distribution of forest wealth throughout the country, a uniformity of demand for forest produce and of opportunity for industrial development, such coordination might perhaps not be necessary. But these conditions do not exist and this fact cannot be ignored.

To take only one example: all provinces are alive to the need for counter-measures against erosion and flood control, and each may take such steps as it considers appropriate or as are within its capacity. Soil conservation however is a nationwide problem and can never be dealt with on purely provincial basis. This is an age of great river-control schemes and the Central Government is in the best position to coordinate action and concentrate effort in the form of organization and funds.

The responsibilities of the Central Government may be briefly defined under three heads: (1) To set up machinery to assist and coordinate in the planning of land utilization and soil conservation; (2) to finance partly or wholly, urgent schemes for the improvement of the catchment areas of great rivers; and (3) in consultation with the provinces, to plan the production of timber and other forest produce.

Despite the growing appreciation of the need and the value of forests, there is still a lack of understanding of the importance of forestry and soil conservation in the economic life of the nation. It is essential, therefore, to educate the public to a realization of the importance of the subject and inform them of the reasons for Government action. For, in a vigorous democratic State, unless the 'demos', our ultimate masters, are alive to their duties and responsibilities, cooperation will not be forthcoming and the execution of a policy however carefully planned, will be hampered at every stage. *P.I.B.*

CONTROL AND ERADICATION OF TICK-INFESTATION IN CATTLE IN BOMBAY PROVINCE*

DURING the course of investigation and disease survey work, cattle in all the districts of this Province were observed to be infested with ticks. The infestation was observed to be heavy in forest areas and hilly tracts.

Damage caused by ticks

The ticks are a menace to the livestock industry and produce harmful effects by mechanical abstraction of blood while on the body of the host. The infested animal is weakened and reduced to a skeleton. The working capacity of the animal is lowered, thus causing economic loss. In milking cows the yield of milk is reduced, while the growth in young stock is retarded. Many fatal diseases are transmitted by ticks. Damage to hides by ticks has been estimated by the Hides and Skin Enquiry Committee to be enormous.

Five species of ticks have been detected viz. *Boophilus australis*, *Hyalomma aegyptium*, *Haemaphysalis bispinosa*, *Rhipicephalus haemaphysaloides* and *Amblyomma species*. The first two species are very common. They multiply rapidly and are very tenacious. They remain without food, hidden in the crevices of cattle-sheds for months together.

Control measures

Various control measures, such as hand-picking, soiling and construction of tick-proof cattle-sheds, dipping and spraying are commonly resorted to. Eradication by hand-picking, singeing and disinfecting, etc. is very cumbersome, tedious and also inefficient. Soiling method which requires elaborate fenced areas in which cattle are to be rotated and construction of tick-proof cattle-sheds are not within the means of the Indian cultivators. The use of chemicals having tickicide properties either in the form of dip and spray is another effective method. This method has been effectively practised in America, Australia and South Africa.

Owing to the peculiar conditions under which cattle are kept in India, and also in this Province, certain amount of research work on dipping and spraying was considered to be necessary to find out a suitable procedure, varying with the conditions prevailing in different parts of this country, for application. As an experimental measure two spraying machines were installed, and two cattle dipping tanks were constructed in 1939-40. Later on three cattle dipping tanks were constructed in the year 1940-41. In all two spraying machines and five cattle dipping tanks are in operation in this Province. The initial expenses for the construction of these tanks were met from the grants from the Local District Boards and funds collected in the villages. The day to day expenses were borne by the Government of Bombay.

Spraying machine

The spraying machine consists of a tank at the base and a platform which is covered on both the sides and on the top. There is an entrance and an exit. The animal is driven in and made to stand on the platform. The tickicide solution from the tank is sprayed on the body of the animal by means of a hand pump. Shower arrangement is such that the whole body is soaked with the solution, which comes in contact with the ticks on the body. The closed sides prevent the fluid from going waste. The method is easy to operate. About 40 to 50 animals can be sprayed with the machine per hour. Cooper's Cattle Dip diluted to 1 : 250 with water is used with satisfactory results. This strength was found to be suitable as a result of experiments conducted for the last six years. Two machines are in use. The machine spraying is, however, not so popular among the villagers because cattle are handled for this operation with difficulty. The machines were originally installed at Kumbhari village in Sholapur District and Hoskulli village in North Kanara District but at both these places the villagers did not avail of their services from the second year onwards. Hence the machine from Hoskulli was removed and installed at Halkar in North Kanara District, and the other at Kumbhari was shifted to Sidenur in Dharwar District. At both these places full advantage is being taken by the cultivators. At Kumbhari on an average 67 animals were sprayed every fortnight and at Halkar 193 animals were sprayed. During a period of six years 16,469 cattle were sprayed. The operations remained suspended during the moonsoon from July to October.

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* Contributed by the Animal Husbandry Department, Bombay. The work on the control and eradication of tick-infestation was carried out under a scheme financed by the Indian Council of Agricultural Research.

Cattle dipping tanks

A cattle dipping tank or bath is a simple long vat made of cement concrete. It is about 30 ft. long and 4 ft. broad. The actual bath in which solution is stored is about 20 ft. long. The water level is 9 ft. at the most. There are slopes both at the entrance and exit which facilitate the animals in jumping in and getting out. The steps are long at the entrance and short at the exit. The animals are allowed to collect in a paddock at the entrance and plunge in one by one. At the exit also, there is a small enclosure in which animals are allowed to stand till the extra solution on the body drips down. The solution flows back in the vat. Iron railings are provided on the sides which are covered by zinc sheets to prevent splashing of dipping solution when the animals jump in. The top is also covered to prevent rainwater falling in the vat. In pre-war period the cost of construction of the tank was about Rs. 775. Now the cost is estimated to be Rs. 3,000. The tanks in this province were constructed from funds collected by the villagers and from grants given by the Local District Boards.

The tanks are easy to operate. They can be constructed locally. In all 97,379 heads of cattle were dipped in these tanks during the period of about six years.

Four private institutions, viz., two Taluka Development Associations and two *Pinjrapoles* have constructed their own cattle dipping tanks and are using them. In one of the institutions (Gilligan Cattle Breeding Farm, Taluka Development Association, Jalgaon) the animals are in the best condition and the sheds are free from tick-infestation.

Dip

It is an established fact that dipping solutions containing Arsenic are very effective and lasting tickicides. Cooper's Cattle Dip, a proprietary preparation, was used in all the tanks except one at Turkewadi where home-made dip consisting of the following was used :

Acid arsenious	8 lb.
Sodium carbonate	24 lb.
Sapo mollis	15 lb.
Pix liquida	1 gallon
Water	500 gallon

The strength of the dip in the tanks is 1: 250. This dilution was found to be satisfactory as a result of experience. In both the cases, Cooper's as well as home-made dip, the same dilution was found suitable. In the beginning a few cases of arsenical poisoning did occur. The ill effects were scalding of the udder, teats and groins. These effects were observed when dipping was done in hot and humid weather. Operations were suspended on such days and these troubles were avoided. Another ill effect of dipping as well as spraying was the shortness of breath that was observed in dipped animals. This effect was noticeable among the animals that were either brought from a distance of three or four miles for dipping or were put to work just after dipping. These ill effects were avoided by dipping the animals on the days they are rested and every cattle-owner was advised to give complete rest to the cattle on the day of dipping. Later on the animals also got accustomed to the dip and symptoms were not marked.

Precautions

The following precautions were observed as a routine to ensure complete eradication of ticks.

(i) Animals were dipped once in a fortnight.

(ii) Dipping was carrird out in the morning as far as possible.

(iii) Before dipping, animals were allowed to rest for sufficient time.

(iv) Dipping of cattle suffering from wounds or skin abrasions was avoided.

(v) The dipping or spraying solution was well-stirred before cattle were allowed to enter in. This was best done by means of a plunger composed of a piece of strong wooden board about 18 sq. inches fixed to the end of a long pole.

(vi) During dipping operations, an attendant stood by with a blunt iron hook attached to a long pole to assist any animal which got into difficulties in the tank.

(vii) Cows and calves were not dipped together owing to the risk of cows injuring calves in the tank. Young calves few days old were hand-dipped, but older ones over ten days or so were able to swim the length of the tank with little assistance.

(viii) Dipping or spraying was suspended during rainy days as the rain water tends to wash the dip out of the animal's skin.

(ix) Great care was taken to prevent over-crowding in the tank to avoid the possibility of one animal jumping over the other and getting injured. Freshly dipped cattle were not allowed to pasture until they ceased dripping, to avoid a danger of poisoning through arsenic-saturated grass. They were detained in shade until their coat was completely dry.

(x) Arsenic of soda and proprietory dipping/spraying fluids were kept under lock and key.

(xi) Persons with ulcerated legs and arms or extensive sores were not permitted to handle the arsenical fluid.

Conclusion

The results achieved so far indicate that the object of the scheme was fulfilled and dipping can be recommended to every big farmer, working in badly tick-infested tract. The cost of running and upkeep could not be calculated correctly as the number was not constant but in a unit of 200 cattle the cost would not exceed Rs. 4 per head per annum. The milk yield of regularly dipped cows was reported to have increased after the dipping operations were introduced in the villages.

During the last three years, there has been a great demand from the public as well as private institutions and rural development boards for construction of cattle dipping tanks. The Bombay Government has a scheme to introduce 20 new cattle dipping tanks in the Province. In seven villages tanks have already been constructed. Further work is being delayed for want of cement and iron for construction of the tanks. The fact that several applications have been received requesting the Government to start cattle dipping tanks, shows that the scheme is well-appreciated by the public. Two sheep dipping baths will also be started in the near future at Javale and Poona.

COCHIN

N. SANKARA MENON

RAINFALL during the south-west monsoon of 1948 did not show any marked variation from the normal and it was well-distributed. The weather conditions being highly favourable, all the crops, especially paddy and vegetables, grew well. Slight damage was done to the paddy crop over a small area in isolated low-lying places; but the crop on the whole was satisfactory and gave good yields.

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Distribution of improved paddy seeds

Paddy is the most important crop in the State covering an area of more than 2 lakhs of acres and any improvement in its yield will raise the economic condition of the people.

Realizing the importance of increasing the yield of paddy by distributing improved strains, the Cochin Government sanctioned the scheme for the rapid multiplication and distribution of an improved variety of paddy seed called Cochin I evolved in the Central Farm, Ollukara. This seed is used for the 'Mundakan' crop, i.e. the second crop of paddy cultivated in September-October and harvested in December-January. The scheme is to last for five years and in the initial stages the work will be confined to the rapid multiplication of the improved seed in the Government Farm and in the fields of private cultivators who will be given a bonus depending upon the quantity of good seed produced by them. The seeds will be distributed among all cultivators when sufficient quantities are available and it is expected that the yield of Mundakan paddy in the State will be increased by at least 15 per cent at the end of five years by the use of improved seeds alone. Breeding work is taken up for evolving a better type of seed for the 'Virippu' (first) crop of paddy and trials are conducted with strains evolved by the Madras Agricultural Department and these will be multiplied and distributed if the trials are successful. At present the staff of the Economic Botanist is strengthened by the appointment of an Assistant to the Economic Botanist, two clerks, one *mistry* and one laboratory boy. Sanction has also been received for the construction of a Botanical Laboratory where the primary work will be the evolution of improved varieties of paddy seeds.

Compost

An intensive propaganda is conducted by the Officers of the Department to induce the cultivators to prepare compost from farm wastes and the method of preparation of this manure is demonstrated in rural areas. The preparation is watched with interest by neighbouring cultivators and the necessity for converting all organic refuse into valuable manure is being realized by them. Compost prepared by Municipalities is used in large quantities in the northern parts of the State while in the southern parts, this manure has not become popular and there is still some diffidence among cultivators regarding its use for their crops. To dispel any misgiving, compost prepared by the Ernakulam Municipality is being used in the Government Farm at Vyttila and this has instilled confidence among them now. People are gradually getting accustomed to the use of this manure and it is hoped that large quantities will be in demand very soon. The question of preparing compost in the other Municipalities is under the consideration of the Government.

Food production drive

The subsidy of 50 per cent on the selling price of any manure used for paddy was continued during the entire season so that cultivators might easily purchase manures and increase the outturn of paddy in the present food crisis. Groundnut cake, ammonium sulphate and bone-meal were stocked in all the taluk depots and *panchayat* depots. Groundnut cake was more in demand than any other manure and the whole quantity stocked in all the depots was soon exhausted. About 500 tons of groundnut cake and 75 tons of ammonium sulphate were issued for the summer paddy (Kole) and the 'Virippu' paddy (first crop) on a subsidized basis. The question of granting subsidy for the second crop of paddy is under the consideration of the Government.

Tractors

The demonstrations on ploughing conducted by the Department with two tractors convinced the cultivators that, under certain conditions, the cost of ploughing operations could be brought down considerably and that large areas could be more quickly brought under cultivation by using tractors than by using bullock power. The hire charge for the tractor for ploughing an acre is only Rs. 10. The reduced cost of ploughing and the speed with which the work is done will be of great help in the food production campaign and requests for the tractors are pouring in from cultivators.

Fruit and Vegetable Farm, Nelliampathies

The Fruit and Vegetable Farm started on the Nelliampathies by the Cochin Government received adequate attention and is making steady improvement. A total of 370 acres has already been planted with oranges while another 30 acres have been planted with miscellaneous fruit trees like mangoes, etc. A few orange plants have begun to flower. The plants are growing well and it will be possible at no distant date to flood the Cochin market with oranges produced within its own boundaries. To fetch additional income, 100 acres have been put under coffee and 50 acres under cardamom.

EAST PUNJAB

JASWANT SINGH

THE partition of the country resulted in mass migration of population in the Punjab. About four million refugees migrated from the West Punjab in Pakistan to the East Punjab in India. This created a huge and unprecedented problem of top-most priority. In addition to normal function of teaching, research and development, the Agricultural Department undertook its share of the rehabilitation work. The Department placed the services of 10 Gazetted Officers and 130 Agricultural Assistants at the disposal of the Deputy Commissioners. The Director of Agriculture took up the duties of Additional Director-General of Rehabilitation (Lands). Most of these men have now been called back to the Department.

Effects of partition

A total area of 57,00,000 acres was abandoned by hindus and Sikhs in the West Punjab, whereas a total area of 45,00,000 acres was abandoned by Muslims in the East Punjab. This would indicate a loss of 12,00,000 acres; but actually the loss suffered by the refugees from the West Punjab was much more than these figures would suggest. The land left by them on that side was more fertile. Out of the total area of 45,00,000 acres abandoned by Muslims, 33,00,000 acres are cultivable. Apart from enormous losses and unprecedented sufferings of individuals, the partition has given a stunning blow to the agricultural industry of the Province. Thousands of fruit gardens which had been planted by the enterprising colonists with the help of the Agricultural Department on most modern lines, and which used to bring enormous income, have also been largely left in the West Punjab. The newly created fruit preservation industry, with its annual output of fruit squashes and juices worth about a crore of rupees has also been lost. The Punjab was likewise proud of its American and other long staple cottons which the Agricultural Department had evolved and which contributed so largely to the prosperity of the province. Here again 95 per cent of the area under long and medium staple cotton, and about 85 per cent of the total cotton area, has been left in the West Punjab.

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Cereals

Before partition the Punjab was leading the whole of India in wheat production and was known as the granary of India. Out of the 10 million acres of wheat area only 3·3 acres has fallen to the share of the East Punjab. As a little more than half of it is unirrigated, wheat production is relatively low in the East Punjab. Although the area under all cereals here is nearly as much as in the West Punjab, being 12·1 million acres, yet the production is only about two-third of the West Punjab, because 75 per cent of the area under cereals is dependent upon rain in this Province.

The Punjab Agricultural and Research Institute was left in Lyallpur. We have lost important Research Stations, most of the seed farms, and fruit experimental stations, valuable records of experiments and research, policies and schemes in the Office of the Director of Agriculture, Lahore, and also the Cereal Technological Laboratory at Lyallpur. So, in a large measure, the Agricultural Department had to be started from a scratch.

Agricultural education

To avoid interruption in the study of Hindu and Sikh students who came away from Lyallpur, arrangements were made with effect from the third week of November 1947, for imparting teaching to them by the Hindu and Sikh staff from Lyallpur at Khalsa College, Amritsar. The Khalsa College continued to be used as a refugee camp till the beginning of January, 1948; the College was thus run in a refugee camp. The initial hardships experienced by the students and staff, therefore, could only be better imagined than described. But, thanks to the ceaseless efforts made by the staff in a missionary spirit, the students were able to finish up the course of study.

Cooperative garden colony scheme

A comprehensive garden scheme has been sanctioned by the Government. The object of the scheme is to develop the fruit industry to the largest extent possible in the shortest possible time, and with the least possible expenditure. Cooperative garden colonies will be established, the size of each varying from 500 to 1,500 acres. A total area of 13,000 acres has been set aside for this purpose. Applications for allotment have been invited and selection will be shortly made. Each allottee will have to devote at least three-fourth of the area to fruit gardening in accordance with the instructions of the Agricultural Department. Fruit plants of the best commercial varieties will be planted in gardens on most modern lines. The allottees shall form themselves into cooperative societies and all the horticultural practices including production of nursery, spraying of trees, packing, grading and marketing of produce, fruit preservation, as also cold storage, will be carried out on cooperative lines.

Cotton research

All the research work on the improvement of cotton crop had been concentrated in the canal colonies which have now gone to Pakistan. It was only in 1940 that a cotton seed station had been opened at Hansi. As a result of research work done here a long staple American variety No. 216 F, popularly known as 'Hariana', had been evolved. It was placed on the approved list a few months ago. Its lint length is 0·92 in. and ginning outturn 33 per cent; it spins 35 counts, and is early ripening. Efforts are being made to increase the area under American cotton in the Ferozepore District, where good irrigation facilities are available. Under advice of the Agricultural Department a few hundred acres have been sown under 4F and L.S.S. in the Amritsar District during the current cotton season. A Cotton Research Sub-station has been established at Jullundur.

Seed farms

With the exception of a seed farm at Abchar in Ferozepore District, all the seed farms have been left in the West Punjab.

Realizing the importance of the supply of seed of improved varieties, the East Punjab Government have sanctioned ten seed farms covering an area of about 10,000 acres. The necessary staff and budget have been provided with effect from 1 April, 1948. Steps are also being taken to establish seed farms in the hilly tracts of the Kangra District. The seed farms will be run on commercial lines.

Departmental seed agencies

In view of the abnormal conditions, it was feared that a large area of land might remain unsown. But, thanks to the combined efforts of the Agricultural Department, Food Department and Revenue Department, 2¼ lakh maunds of wheat seed and 1 lakh maunds of gram seed was secured and supplied to the cultivators.

Vegetable cultivation

Fearing that the season for sowing vegetable nursery might be over by the time the refugees from Pakistan were able to settle on land, Managers of all Government Farms had been instructed to sow maximum area under vegetables, partly to meet the shortage of vegetables and largely to supply the nursery seedlings to the refugees. As a result, lakhs of plants were supplied to the public which contributed greatly to the mitigation of vegetable famine, which had been considered imminent. About 25 maunds of indigenous vegtable seeds and 1,000 lb. of English type of vegetable seeds were supplied to the growers. The latter were imported from Kashmir by air.

Commodity schemes

The Indian Central Sugarcane Committee has sanctioned research and development schemes on sugarcane for the East Punjab and has generously decided to meet the entire cost of these schemes amounting to about 13 lakhs of rupees. Three schemes were submitted to the Indian Central Cotton Committee, namely (i) scheme for the breeding of American cotton suitable for the submontane districts, (ii) supply of 4F American cotton seed in Ferozepore and (iii) breeding of long staple cotton in the East Punjab. These schemes have been sanctioned, and the Committee also acceded to the Province's request to bear the entire cost amounting to about 2·9 lakhs of rupees.

'Grow more food' schemes

As a result of partition of the Province a large number of 'grow more food' schemes, which were functioning in the undivided Punjab came to a close. These were revised and were resubmitted to the Central Government. These include the following :

(i) Sinking of 30,000 surface percolation wells involving an expenditure of 2·11 crores on subsidy and overhead charges, which will irrigate 3 lakhs of acres.

(ii) Installation of 1,500 tube-wells involving 1·29 crores as subsidy and overhead charges, which will irrigate 3 lakhs of acres.

(iii) Extension of crops for green manuring, involving an expenditure of 4·7 lakhs of rupees on subsidy and overhead charges during a period of four years. This will cover an area of 27,000 acres every year.

(iv) Manufacture of compost from town-refuse and village waste material involving an expenditure of 9 lakhs of rupees during four years.

Other schemes

A number of schemes jointly financed by the Indian Council of Agricultural Research and the Punjab also came to a close. These were revised and resubmitted to the Council. These include schemes (i) for improvement of maize crop, (ii) research on soyabean crop, (iii) research on insect pests of stored cereal grains, (iv) establishment of regional bee-keeping research stations, (v) investigation of wilt disease of gram, (vi) cultivation of some important medicinal plants, (vii) control of insect pests of vegetables, (viii) control of wheat rusts in India, and (ix) rapid enquiry into fat, solids not fat and specific gravity of milk.

Rehabilitation

Allotments of agricultural lands which have been made so far are temporary. As a rule all allotments are made on group basis. The object is to organize an improved system of farming on the basis of joint village management. Within the framework of group allotment each family will cultivate the area assigned to it. If there are ten families in a group, the land will be divided into ten work units without regard to the individual to whom different units are to be allotted. It will be in the interest of each community to ensure that the units are demarcated as fairly as possible. Thereafter, the participating families can draw lots to determine their own share of land. Group allotment means joint management and joint possession.

Across the Borders

NEW USES FOR AMERICAN FARM CROPS*

By H. T. HERRICK

IN 1938, the Congress of the United States authorized the establishment of four regional laboratories to work on new scientific, chemical and technical uses for agricultural raw materials. The Northern Regional Research Laboratory in Peoria, Illinois, is assigned the task of finding new uses for corn, wheat and the less important cereal crops; soybeans and other oilseed crops of the area, and agricultural residues.

Northern Laboratory

Starch is the most important component of the cereal crops. There is a starch acetate fibre, for instance, that has certain properties all its own, although it resembles the cellulose acetate material that is prepared from cotton linters and other cellulosic raw materials. There is saccharic acid, which may find wide use as a food acid, and there is a family of products that stem from the action of micro-organisms on starch or the corn sugar manufactured from starch. Penicillin is the outstanding product of fermentation. Another part of the work with fermentation is making alcohol from the starch found in the cereal grains of the Midwest.

Besides starch, all cereals contain proteins of various types. When starch is manufactured from corn, these proteins are found in the so-called corn gluten, which is ordinarily used for cattle feed. This gluten is treated industrially with alcohol to extract an alcohol-soluble protein known as zein. Research has indicated the possibility of using zein in the production of a promising industrial fibre which, in both wet and dry strengths and in other properties, compares favourably with fibres prepared from other protein materials. Zein has also found wide industrial use in shellac, printing inks, and adhesives.

Much of the research on soybean oil has been devoted to improving its properties. For example: Soybean oil in storage may develop unpleasant flavours that make it undesirable for use in cooking fats, salad oils, and other foods. Research workers at the laboratory have studied the problem for several years and have made progress in correcting the difficulty. For paint, soybean oil does not dry fast and hard enough to be used for the best type of surface coatings. A new chemical treatment can cut the drying time of the oil without affecting its other properties. Other materials produced from soybean oil are Norepol, a rubber substitute and Norelac, a thermoplastic resin. Norelac is largely used as a heat-sealing and water-proof coating for paper and food packaging.

One use for cornstalks, straw, and similar material is to make a substance that replaces sand for cleaning machine parts, castings, and so on. It is expected that with the increase in the cost of wood, agricultural residues, like straw and stalks, will find a wider use in making paper.

With a new process, it is possible to produce from agricultural residues furfural, a colourless, oily liquid used in purifying butadiene and making plastics, that has great promise as the basis for a new chemical industry; glucose, from which alcohol can be made cheaply; and lignin, a material that is now used as fuel but has great possibilities for chemical development.

Southern Laboratory

Research at the Southern Regional Research Laboratory deals primarily with cotton. Research on tire cord has been undertaken, with the object of developing a still better cotton cord for use in tires for heavy trucks and buses. By means of a modified mercerization process, standard cotton gauze may be made semi-elastic and used to advantage in bandages for several types of injuries. This new all-cotton material will bend and give with the flexing of a joint and will expand if there is swelling; it seems indicated for cases where a mild-pressure dressing is required. The Southern Laboratory has developed a treatment to preserve fabrics against mildew and bacterial rot by partial acetylation of the cellulose of the cotton fibre, so that it is more practically proof against attack by cellulose-destroying organisms.

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* From *Yearbook of Agriculture* (1943-47), United States Department of Agriculture.

For many years gossypol was the only pigment known to be associated with cotton seed. Research led to the detection of many other pigments, three of which have been isolated and identified: Gossypurpurin, purple in colour, and gossyfulvin, orange in colour, both of them from raw cotton seed, and gossycaerulin, blue in colour, from cooked cotton seed.

Eastern Laboratory

The commodities studied at the Eastern Regional Research Laboratory, near Philadelphia, Pennsylvania, comprise milk, tobacco, animal fats and oils, vegetables, apples, hides, leather and tanning materials. Whey, a by-product in the production of cheese and casein from milk, contains lactose, or milk sugar, which can be transformed into lactic acid by the action of certain micro-organisms. From lactic acid a material known as methylacrylate can be produced. When this methylacrylate is combined with such materials as butadiene and isoprene, it can be converted into a rubberlike material known as Lactoprene. The resulting materials are resistant to oil, oxidation, sunlight and heat.

The kind of synthetic rubber now being produced in greatest volume results from the combining of butadiene and styrene while they are suspended as minute globules in an emulsion. Much difficulty was experienced with the soaps that were used to prepare the emulsion. Because about 90 million pounds of tallow a year are needed for such soap, the Eastern Laboratory, in cooperation with the Rubber Reserve Company, undertook an investigation of tallow and tallow soaps in order to determine the effect of minor constituents of the tallows on the polymerization process. The investigators found that the presence of certain minor constituents in the soap was largely responsible for the retarded polymerization of the synthetic rubber. They also learned that a hydrogenation of the tallows before they were used for the preparation of soap would completely eliminate the troublesome variability in the finished soap. As a result of the work, the Rubber Reserve Company specified that all its soap in 1946 be hydrogenated to a precise degree. The requirements can be met by the use of non-edible tallows and greases, instead of edible tallows as formerly used. The research contributed substantially to the synthetic rubber programme.

It was found that leather goods and equipment used in the tropical atmosphere were in many cases seriously damaged by mould growth. The Eastern Laboratory developed several compounds and treating procedures to meet this difficulty. Of these compounds, three were found to be especially effective when applied to completely fabricated leather equipment, and gave greatly increased resistance to both moisture and mould growth. These compounds are composed of salicyl anilide paranitrophenol, and dinitro-ortho-cresol.

Western Laboratory

Fruits, vegetables, alfalfa, poultry, and wheat are the crops assigned to the Western Laboratory. More than a billion pounds of dehydrated vegetables were produced during the war. Several important discoveries made at the Western Laboratory helped make possible this production. It was shown, for example, that easily controllable factors, such as moisture content and the composition of the package atmosphere, are effective in preventing rancidity and staleness in many kinds of dehydrated vegetables.

Commercial production of spray-dried whole egg-powder was greatly increased during the early months of the war to such an extent that egg-drying became a major wartime industry in the United States, with an annual volume of 300 million pounds. Serious trouble developed with the spoilage of stored egg-powders. It was found that the control of acidity during the drying and storage of eggs will extend by at least four times the useful 'shelf life' of the product. The beating or whipping properties of unacidified spray-dried eggs are poor, while those that have been properly acidified before drying are about equal to fresh eggs. The process consists of adding a small amount of hydrochloric acid to the eggs before drying. After dehydration, enough sodium bicarbonate is mixed with the dried powdered eggs to neutralize the acid. Upon reconstitution of the powder with water, the reaction between the acid and soda forms a small amount of sodium chloride. The salt thus introduced is barely detectable.

Research on frozen fruit is an important activity at the laboratory. A large share of them was treated with a sodium bisulfite bath to prevent darkening. It was noted that scalding sweet corn on the cob before removing and freezing the kernels gave a better product than when removal from the cob is the first step. Progress has been made in solving the problem of preventing the development of undesirable flavours in frozen peas.

It has been found that some wastes from canneries and freezing plants can be employed as culture media to grow useful yeasts, moulds, or bacteria. One example is the use of pear cannery waste in the production of a feed yeast rich in proteins and vitamins. Another possibility under investigation is the use of the wastes as a culture medium for the production of antibiotic compounds. The juice from waste asparagus butts is especially suitable for this purpose. Among the antibiotics being studied are tyrothricin, citrinin and subtilin. Subtilin was discovered and named by the Western Laboratory in 1943. Preliminary indications are that subtilin may be hepful in treating tuberculosis and amoebic dysentery. The use of these and other similar antibiotics also is being investigated for the control of plant diseases.

Investigations on different phases of fibre production from proteins are under way in all four regional laboratories. At the Western Laboratory the proteins are the keratins (important constituents in feathers, hooves, hair and horn) and the proteins from wheat, alfalfa, and egg white. Each has been used in the experimental production of fibres, plastics, and adhesives. (*Released through U.S.I.S.*)

FOOD TECHNOLOGICAL INSTITUTE

THE Prime Minister, Pandit Nehru, opened on December 29 the Food Technology Institute of the Government of India at Mysore. The Prime Minister thanked the Government of Mysore for placing a building at the disposal of the Government of India for this purpose and hoped that similar Central Institutes would be spread all over India.

The importance of food technology was obvious, he remarked, and given proper facilities for production, India could produce enough food for her people, and the need for imports might be wiped out. The Prime Minister also suggested that people should shake off their conservatism and not insist on a particular type of diet.—*Food Bulletin*, January 10, 1949.

Home Gleanings

HIRAKUD DAM PROJECT

LAYING of the concrete foundation stone of the Hirakud Dam, the first step in the execution of the scheme of multi-purpose development of the Mahanadi Valley, marks the dawn of a new era in the history of independent India. This is the first major valley development project to be sanctioned for construction in India after independence and Pandit Nehru, in laying its foundation stone, has really laid the foundation of the rapid and progressive development of many other river valleys in India. The utilization of water resources for purposes of flood control, irrigation, hydro-power generation, navigation and other facilities such as agriculture, malaria control, soil conservation, etc. is so vitally necessary for fighting starvation, disease, illiteracy and squalor which afflict vast multitude of India. The Hirakud Dam is the first of the three dams to be constructed with their canal system and power installation on the Mahanadi River. The construction of the projects would unfold vast opportunities to the people of Sambalpur and Orissa to display their initiative and skill in the fields of planning, research, construction and industrialization.

The dam

As the Premier of Orissa aptly said, a halter is now to be put round the neck of the great river Mahanadi, so that it may not behave like a wild animal taking pleasure in destruction, carrying all before it as it goes on with its demon dance but that it may be tamed and made to yield immense prosperity to the province. When the dam is completed—according to schedule this will be by 1953—it is estimated that the river will hold water to irrigate over a million acres of land. Power to the extent of 350,000 k.w. can be generated and with this available supply of power, hitherto unexplored and unexploited resources of the province such as aluminium, steel, paper, cement and textile industries can be developed to the utmost extent around Sambalpur.

The magnitude of the task undertaken is immense and the mention of a few details will not be out of place. The Hirakud Dam project comprises the construction of a dam across the Mahanadi about nine miles up stream of the town of Sambalpur, gravity and lift canals on either side and hydro-electric installations. The dam will be nearly three miles in length across the main channel with 17 miles length of two dykes on the two sides. The maximum height of the dam above the deepest river bed will be 150 feet. The reservoir formed by the dam will submerge an area of 1,35,000 acres of which nearly 70,000 acres will be cultivated land. The gross storage capacity of the reservoir will be 5·3 million acre feet of which 1·2 million acre feet will be dead storage to serve as silt reserve and to produce head for generating power. The rest 4·1 million acre feet will be usable storage for use of irrigation, hydro-electric power and flood control and for improving navigation facilities. The storage of water far from adversely affecting the water rights of the upper and lower riparian States including the Central Provinces will, on the contrary, be beneficial to the States in as much as the excessive floods will be controlled and the minimum dry weather supplies materially improved.

Irrigation

The dam will irrigate 10,94,953 acres of land of which 8,80,000 acres will be in the Sambalpur District of Orissa and the rest in Sonepur State. Besides, the regulated supply will provide protective irrigation to existing irrigated areas in the delta during critical periods of short supply, and enable perennial irrigation to be extended to additional large areas in the delta which at present cannot be brought under irrigation as they may get submerged during floods. The extent of the area of this latter category will be considerable.

Generation of power

At two parts of the dam, two power houses with operating heads of 85 feet each will be constructed for generation of power. The total installed capacity of the two houses will be 3,50,000 k.w. with six units of 25,000 k.w. each installed at the upper power station and eight units of 25,000 k.w. each at the lower power station. The system will be capable of making a maximum demand of 3,00,000 k.w. making available about 1,612 million k.w. hours annually. It is expected that the Hirakud power station will, in time, be linked up in grid to the proposed power stations at Tikarpura, Naraj, Kosi, Tista, Damodar and others. The rate structure of hydro-electric power will no doubt be on the lines of generally accepted principles, that is, the size of the load, load factor, the distance of transmission and the nature of the industry concerned will be the determinant factors. The rate for pumping has been fixed very low at Rs. 20 per k.w. per year, which means there will be an element of subsidy in the interest of the 'grow more food' campaign which will continue to be our main concern to make us independent of the foreign supply of food at exorbitant prices and thus to meet the deficit in our external balance of payments. The rates for industrial and other loads will progressively fall from Rs. 160 for an installed capacity of 1,00,000 k.w. to Rs. 400 for an installed capacity of 25,000 k.w. Special concessions will, of course, be made to the rural consumers. Availablity of cheap power being the ruling factor behind industrialization, industrial opportunities of Orissa with its large deposits of the minerals within easy reach and its population which is five times that of the Tennessee Valley in the U.S.A. seem to be abundant.

Flood control

As flood control is one of the main objectives of the construction of the dam, it will be so arranged that peak flood supplies will be stored in the reservoir at Hirakud and will be regulated in such a way that the limiting flood gauge of 90·9 at Naraj is never exceeded and the safe flood gauge of 89·0 is exceeded only in extraordinary floods and that also only for a few days. That is how material relief will be afforded to the delta area and the riverain areas in States lower down.

Facilities for navigation

The Mahanadi river, at present, provides very little facilities for navigation. Whereas in the monsoon months navigation is dangerous due to high floods, during the rest of the year the current is sluggish with poor discharge, being as low as 900 cusecs in bad years. The construction of the dam will bring about revolutionary changes in the navigable capacity of the river in as much as the regulated releases of water from the reservoir to the river down stream of the dam will range between 8,800 and 14,000 cusecs during dry seasons. If the jutting rocks in the river bed are blasted and some conservancy measures are undertaken, it may be possible for 600 to 800 ton tows to ply from the sea to Dalab and thence through the canal up to the Central Provinces. Inland ports at Cuttack, Dasapur, Tikapara, etc. and a major deep sea port at Chandbali or Dhamra may be developed. This major port, it is estimated by experts, may be capable of handling nearly 6 million tons of traffic. The annual traffic, it may be noted, handled by the port of Calcutta in pre-war days was nearly 10 million tons. This will also make possible cheap transport of agricultural and industrial produce of the Valley for local distribution and export abroad. It is also considered that the eleven miles long power-cum-navigation canal with its water depth of 17 feet to 20 feet will provide an ideal place for navigational research.

Control of malaria

Malaria being more or less prevalent throughout Orissa and the Eastern States, the building of an extensive reservoir may be a convenient breeding ground for malaria-bearing mosquitoes. Hence a malaria expert has been appointed to advise on adequate steps for control of malaria, which will form an essential feature of the project. Measures broadly on the lines of the Tennessee Valley Authority in U.S.A. will no doubt be adopted. Besides this project will open opportunities for soil conservation, silt control, pisciculture and recreation. This will also provide a sea-plane base at a strategic location.

Cost

Calculating on the basis of rates ruling in December 1946, the project is estimated to cost Rs. 47·81 crores to be completed within six years. This multi-purpose development project has been made possible because of the grant of a loan of Rs. 48 crores to Orissa by the Central Government. It is expected that the project will pay a return of more than 4 per cent in the fourteenth year after start of construction. Though no direct revenue is expected from flood control, it will make a saving of nearly Rs. 12 lakhs a year in flood damage to the delta and in helping reclamation of flooded lands, etc. It has also been estimated that the net revenue from irrigation will be to the tune of Rs. 1,72,18,750. Over and above the financial returns, there will be considerable indirect benefits by way of increased food production (an annual increase of 3,40,000 tons is estimated in Sambalpur District and Sonepur State alone), development of basic industries which will make provision for employment to millions, etc.

No opposition

Considering that the reservoir will submerge an area of 1,35,000 acres of which 70,000 acres is comprised by cultivated lands, some discontent among the people affected could be expected. Such discontent was manifest when the major dams in the Punjab, Mysore and in the Tennessee Valley were undertaken. But in the present case, it is gratifying to find that the people of the affected locality of Orissa have risen equal to the occasion and have most gladly agreed to undergo the requisite sacrifice, for the greater good of the country. According to the Premier of Orissa, 'the notable feature of the today's concrete-laying ceremony was the complete absence of opposition to the construction of the dam from any of the villagers'. Nonetheless, the Government have got a tremendous responsibility for rehabilitating the people of the villages in more congenial environment, if possible, and make adequate compensation. Here is a chance for the Government to set up model villages with provision of essential amenities like drinking water, sanitation, public schools, community centres, electricity, etc. So far as possible, compensation should be in the form of land in exchange for land considerably ahead of the actual date of submergence. As the States in Orissa have been merged with the province the problem has been made much easier.

A bold step

Hirakud project represents the efforescence of the constructive genius of man, of his undaunted will to subdue and bend the forces of nature, to serve a great social purpose. In the great design for India's economic future, it has its assured place. But above all, it is to be welcomed as marking the translation of a plan into action, the inauguration of a period of bold, imaginative advance in contrast with pious wishes and 'paper planning'.—Reproduced from the *Eastern Economist*, April 23, 1948.

Book Reviews

KHETI KI REETI (HINDI)—PARTS I AND II

By N. D. VYAS (Leader Press, Allahabad, Pt. I : pp. 273, Rs. 3 ; Pt. II : pp. 161, Rs. 2).

THE book on the 'Method of Cultivation' is a companion to the author's two books published earlier in Hindi and entitled *Fruit Cultivation and its Marketing* and *Vegetable Cultivation*. Part I deals with the food grain crops and their marketing. It is divided into thirteen chapters. The first chapter is devoted to general observations with regard to climate, land and its tillage, manure, rotation of crops, seed and its sowing, weeding, hoeing, watching, irrigation, crop enemies and methods of guarding against these, crop production, yield, distribution and marketing, uses and qualities. The next twelve chapters are given over to crops, e.g. wheat, paddy, oats, barley, *jowar*, *bajra*, maize, Italian millet, *kodon*, common millet, *ragi* and little millet. In part II, the pulse and oilseed crops are dealt with and this part is divided into twenty-two chapters—the first fourteen chapters relate to *urd*, *kirao*, *kulthi*, horse gram, *khesari*, *guar*, gram, cowpea, *arhar*, lentil, peas, *moong*, kidney bean, soyabean and *sem* and the following eight chapters are devoted to linseed, castor, safflower, poppy, *til*, groundnut, *niger* and *sarson*.

In his treatment of these crops, the author has given information about the varieties, general description of plants, economic classification, acreage and yield and has followed under each crop the outline adopted by him in the first chapter of Part I. The data regarding acreage and yield will have to be amended in view of the partition of country and consequent redistribution of provinces.

The book is the result of a careful study and embodies all the information that is needed about the crops that have been dealt with in both the parts. The book will doubtless be useful both to the students of agriculture and others interested in agriculture. It is written in simple language and in a good style. The get-up of the book is also good. It is hoped that the book will be widely read. (B.L.S.)

News and Views

THE TREND OF BRITAIN'S AGRICULTURE

By A. G. STREET

NINETY per cent of Britons live and work in towns, and so by their voting power they rule the destinies of British farming. Between World Wars I and II they showed no great interest in home food production. Some held land for power; others for social position; others again for sporting purposes; the national Church took a tithe from it; and it was generally accepted as the free playground for 40,000,000 townfolk during their leisure. When all these demands had been satisfied and not before, the farmer farmed the land; and surprisingly not only produced a material proportion of the national income, but was also well to the fore in agricultural development and research.

Disliking the prevailing policy, and knowing that livestock production was the easiest farming and slowest way to the bankruptcy court, the British farmer laid most of his land down to grass. Never before in history has Britain's luck been so definitely proven. In trying to save himself, the farmer unconsciously saved the whole nation when World War II came in 1939. For underneath the turf of much of his grassland lay a great store of fertility.

This was tapped by the plough during World War II and enabled British farming to fight and win at least half the Battle of the Atlantic. This triumph showed how very different is the demand of the British nation from its farming land during peace and war. During peace and plenty it calls for the maximum money value per acre, of first quality perishable fresh foodstuffs, largely livestock products. During war and famine it demands the greatest weight of human food per acre, grain, potatoes and sugar-beet—in other words, crop farming. The former depends largely on grassland; the latter on the plough.

When World War II ended the British farmer naturally expected to be 'not wanted' once again; and so immediately planned to get back to grass and livestock as quickly as possible. He knew from bitter experience that this type of agriculture provided him with the best chance of competing with overseas agriculture, and at the same time was best suited to a damp temperate climate.

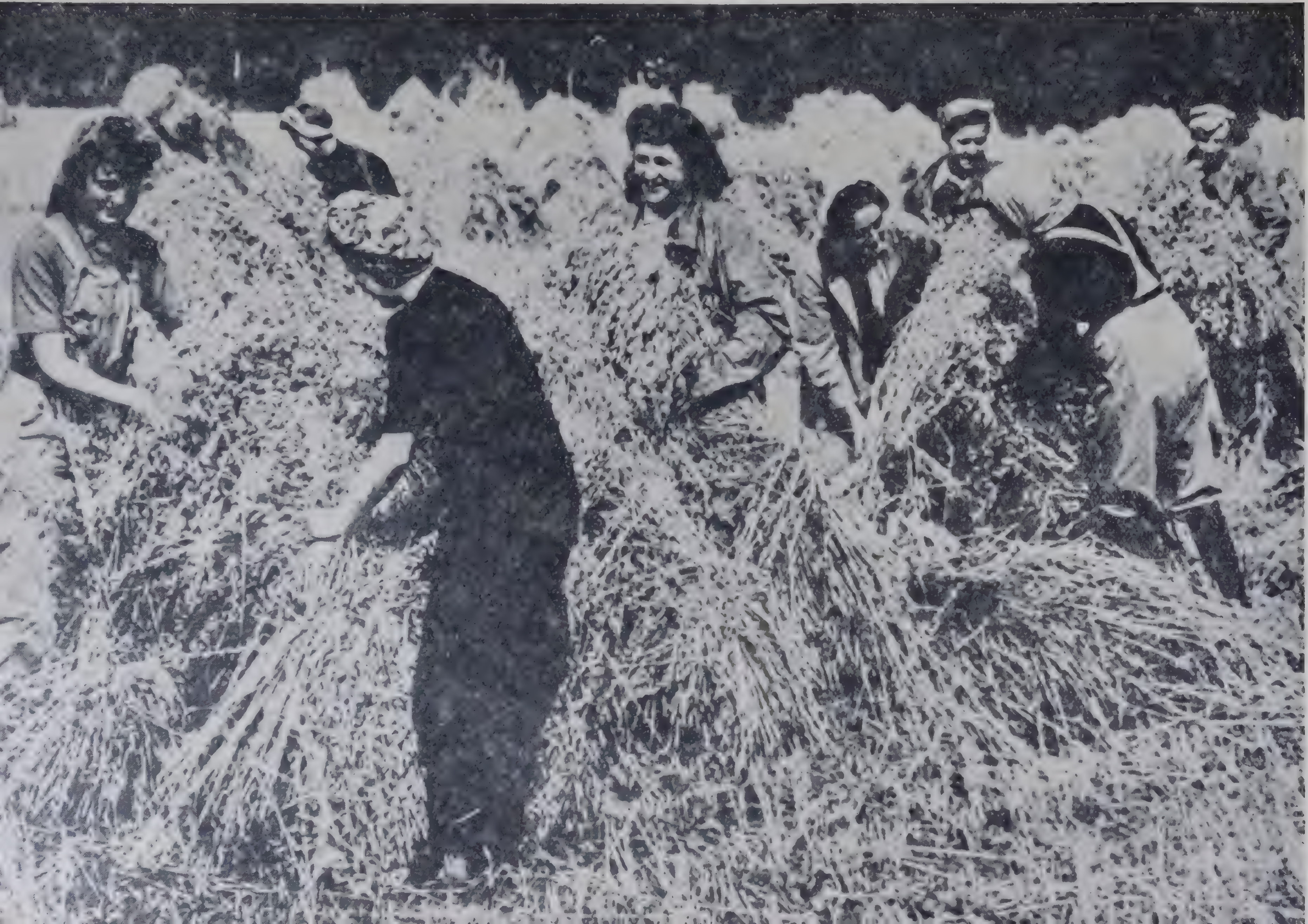
To his surprise one year of peace brought an even greater fear of famine, famine because of the national inability to purchase food *ad lib* from overseas. So today he is being urged to still greater production from his land, of both cereals and livestock products.

For the moment, then, he must, be more or less, self-supporting. There is no money to buy imported feeding stuffs, so he must grow his own. This, perforce, makes him a ley farmer; using temporary grass instead of permanent for his stock, breaking up a proportion of this every year to grow cereals, and laying down a similar proportion to a new ley. This means an elastic farming, ready to extend in whatever direction the times demand. But the British farmer is hoping that the need to grow all his feeding stuffs at home will be only of a temporary nature.

As long as there is a world shortage of food, Britain will continue to farm for a high calory output—grain, potatoes and sugar-beet. Sooner or later, however, she hopes to turn more to grass and stock, developing the production of fresh milk, fresh eggs, fresh meat, fresh fruit and fresh vegetables. There is no likelihood of any very marked change in the lay-out of Britain's countryside, because in livestock farming the small man can compete quite well with the larger tillage farmer. So, unless the world is completely mad, the lovely patchwork quilt of the little fields of Britain will remain unchanged.

Farmers in large agricultural countries overseas often suggest that except during war, Britain should not bother about farming her little patch of land, but should be content to

Fig. 1. -Harvest Home. Landgirls stocking wheat in a Surrey field.



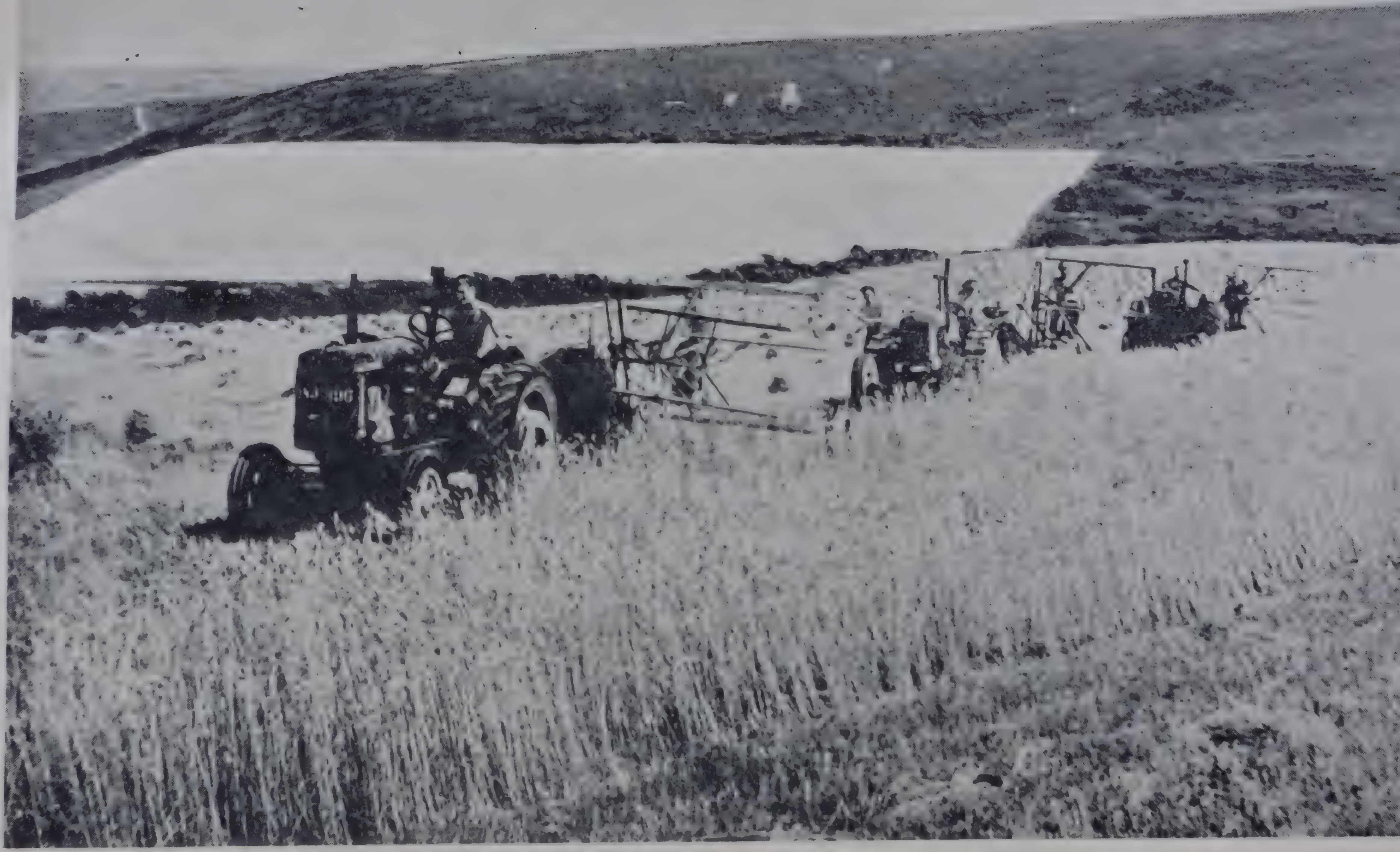


FIG. 2. Wartime training areas being converted into rich agricultural land in Sussex Downs.

buy her food from overseas. There are two reasons why they should change this view. One is because a prosperous livestock agriculture in Britain will always be a very good customer of the overseas farmer, purchasing cotton cake, linseed cake, soyabean, palm kernel and cereals in huge quantities to feed livestock here. The other is because the small acreage of farming land in Britain can be likened to the back garden of a household, in this instance of a household of 47,000,000 people.

As the ordinary household uses its back garden to grow the vegetables that it prefers fresh, and buys the non-perishables, like potatoes, from the shops, so will Britain use her back garden to produce the foods she prefers in fresh condition—meat, milk and eggs, at the same time buying non-perishables like wheat from overseas. Moreover, any household, large or small, which is too lazy or too foolish to tend its back garden decently, will deserve and may experience hunger and discomfort.

But the recent lesson of hunger, not yet finished, has been, and still is, too painful to be forgotten in a hurry. History shows that ever since the Industrial Revolution in 1830 Britain has granted prosperity to her farming only during occasional short periods of war and famine. The resolve today is to base its prosperity on more wholesome things, peace and plenty. British people never want again to have to repeat Ralph Hodgson's lines:

‘I saw in vision the worm in the wheat,
And in the shops nothing for people to eat,
Nothing to eat in Stupidity Street’. (*B.I.S.*)

THE INDIAN SOCIETY OF AGRICULTURAL STATISTICS

THE Second Annual Meeting of the Society was held at New Delhi from 23 to 25 October, 1948. Dr Rajendra Prasad, President of the Society, delivered his address on 23 October, 1948. Stressing the importance of correct and reliable statistics, Dr Prasad said that accurate statistics formed the foundation of all our future planning. The work that the Society had undertaken was, therefore, of the highest national importance. He then referred to the progress already made in the methods of collection of agricultural statistics and said that the method of random sampling devised by statisticians for this purpose marked a great advance, and he was glad that the method was being extended to all the important crops in the country. Along with this question was also that of the cost of cultivation of crops which was also equally important, and he urged statisticians to devote their attention to finding out the cost of production of the various crops and thus help the Government in their efforts to control and fix the prices of commodities. The work of the Society, he continued, would likewise be of value to the Government in determining the extent and the method of distribution of the aid which the Government is planning to give to the agriculturists. Speaking of India's cattle wealth, Dr Prasad said that the absence of accurate statistics was more pronounced in animal husbandry, especially because of the difficulties peculiar to that field. Yet, even there, one should not under-estimate the need of having accurate information not merely of the number of cattle in the country, but of their individual worth. He then referred to the World Agricultural Census to be held in 1950, in which India had agreed to participate, and asked the statisticians to consider whether it could be carried out jointly with the population census without loss of efficiency.

Earlier, Dr P. V. Sukhatme, Secretary of the Society, in his report of the year's activities, said that in the publication of a scientific Journal, which was one of the Society's principal activities, they had to meet with great difficulties, first, for lack of funds and secondly, for want of a suitable printing press equipped with mathematical and statistical types. He was, however, happy to place before the meeting a specimen copy of the first number of the Journal which had just been received from the press. A special feature of this Journal was the Hindi supplement giving summaries of the articles published in English. The Society had also prepared a glossary of Hindi equivalents of all principal terms in statistical science.

On 24 October, a symposium on the 1950 World Agricultural Census was held under the chairmanship of the Hon'ble Shri Jairamdas Doulatram, Minister for Agriculture, Government of India. The meeting was well-attended by a number of statisticians and those interested in agriculture from the Centre and the provinces. Emphasizing the importance of the role of statistics in the formulation of economic planning, the Hon'ble Minister urged statisticians to devise ways and means of collecting statistics which were true, accurate and dependable; 'for, no progress is possible in any field unless we are able to see the path we are treading or the goal we have to reach, and reliable statistics is the lamp that lights our path'. Emphasizing the need of having a reliable census, he exhorted statisticians to produce statistics which for their accuracy and dependability could not be challenged and which will put India on a par with other countries in this field. He suggested that for this purpose, the non-official element in the country should be mobilized to cooperate with and help the Government in its task. This would help to remove suspicion and hesitation from the minds of the public and prepare the way for accurate results quite in contrast with the censuses in previous years. In conclusion he suggested that a 'rehearsal census' should be held in 1950 as a preliminary to the census in 1951.

The main speakers included Shri W. R. Natu, Economic and Statistical Adviser, Ministry of Agriculture, Mr. M. W. M. Yeatts, Census Commissioner, Government of India, Shri Shri Ram, Patron of the Society, Prof. J. N. Warner of the Agricultural Institute, Allahabad, Shri G. M. Sankpal, Director, Bureau of Economics and Statistics, Bombay, Dr N. S. R. Sastry, Reserve Bank of India, and Dr P. V. Sukhatme, Secretary of the Society.

Following the symposium a number of technical papers bearing on topics of interest to agricultural statisticians were read. Prof. Madhava was in the chair. The reading of papers was continued on the afternoon of 25 October with Shri R. S. Koshal in the chair. The session concluded with a public lecture on the 'Standardization of Agricultural Products' by Dr T. G. Shirname, Agricultural Marketing Adviser to the Government of India.

Among the messages of greetings received on the occasion of the Second Annual Meeting of the Society were those from Dr C. V. Raman, the noted Indian scientist, and the Hon'ble Shri N. V. Gadgil, Minister for Works, Mines and Power, Government of India.

Shri Pheroze Kharegat was elected by the Society as its honorary member as a mark of its appreciation of his services in the cause of Indian agriculture. Prof. N. G. Ranga was elected as an additional Vice-President of the Society during the year. (*I.S.A.S.*)

COVER ILLUSTRATION

Potato growing in the Nilgiris. Planting the seeds.

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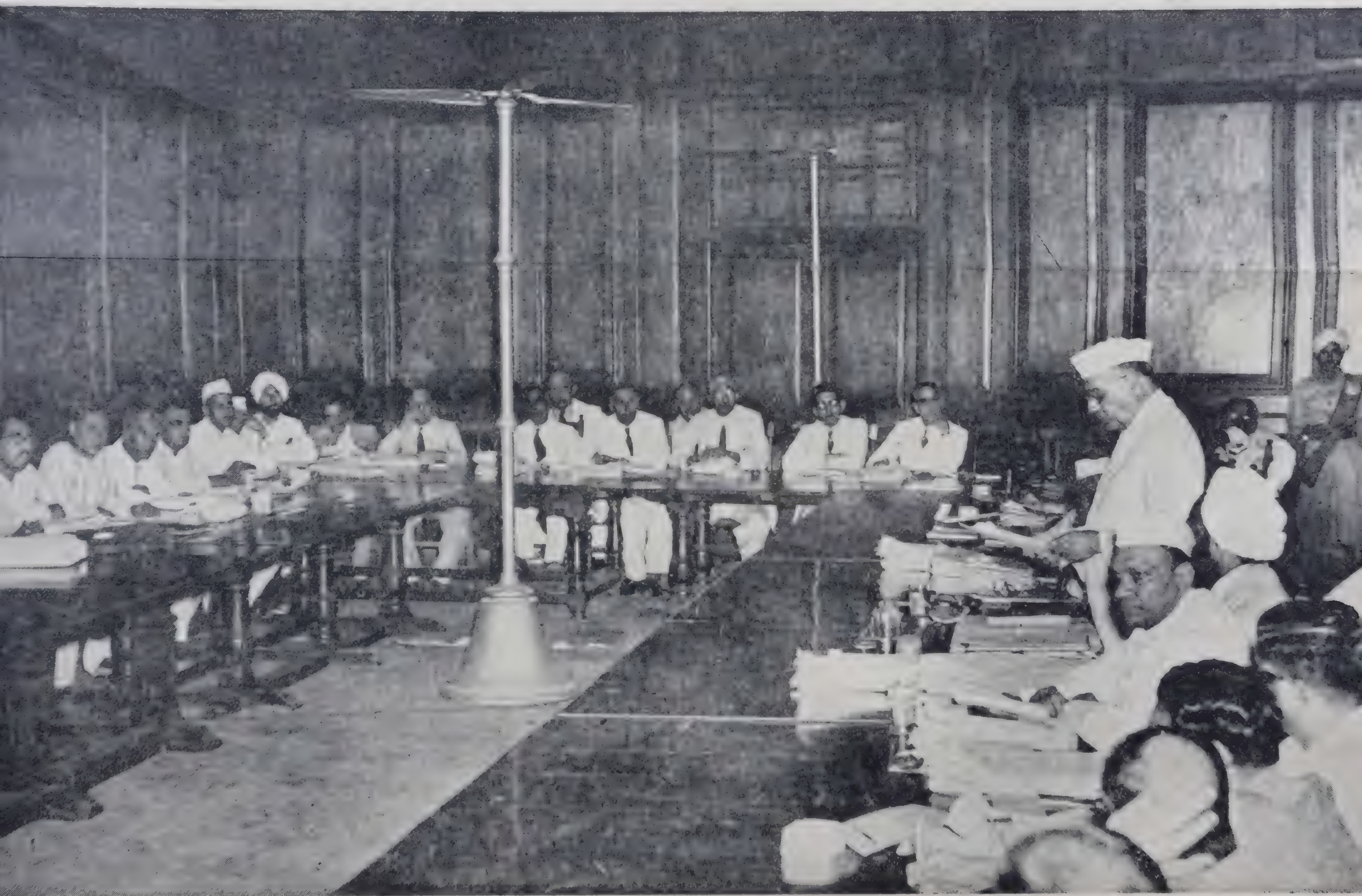

Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, addressing the tenth meeting of the Indian Central Sugarcane Committee which was held at New Delhi on 9 October, 1948.

INDIAN FARMING

FEBRUARY, 1949

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AGRICULTURAL RESEARCH IN INDIA

THERE was no organization at all for agricultural research in the country till the beginning of this century. There was no deliberate planning even then but a series of famines forced the conclusion on the Government that the agricultural economy of the country could be improved only by applying scientific methods to crop and animal production. A beginning was accordingly made and in 1903 a Central Agricultural Institute was set up at Pusa in Bihar and certain grants were made to the Provincial Governments from 1905 onwards for the development of agricultural research and demonstration on problems of local applicability. The Pusa Institute gradually developed and separate departments of agriculture were set up in provinces and in some, agricultural colleges were started. But progress on the whole was slow. Then in 1926 a Royal Commission on Agriculture was appointed to go into the whole question of Indian agriculture. The Commission emphasized the necessity of setting up an all-India Council of Agricultural Research charged with the task of initiating, organizing and coordinating research on scientific lines. The Imperial (now Indian) Council of Agricultural Research was accordingly set up in 1929. A new era of development in agricultural research was thus ushered in full of promise for the country's rural economy. The Indian Council of Agricultural Research worked as a separate Department of the Government of India for nearly 10 years when in 1939 it became an Attached Office of the omnibus Education, Health and Lands Department. The exigencies of war and the Bengal famine brought home to the Government of India the necessity of paying greater attention to agricultural production and research than had been done hitherto and so a separate Department of Agriculture was created on September 1, 1945.

The Council set about building its edifice steadily and took advantage of the spade work that had been done already. It took up agricultural research work on a coordinated basis and undertook investigations on problems of immediate economic importance to the cultivator both on cash and food crops. It also subsidized a number of village projects with a view to seeing that the results of research were translated into actual farming practices as far as possible.

In the field of crop production rice occupies the foremost place. The Council gave great impetus to its improvement and subsidized a chain of schemes all over the country. Most of these schemes terminated during the period 1941-45. As a result of investigations on the breeding side, a large number of varieties have been produced suitable for high and low-lying areas, resistant to flood, drought and saline conditions or to the attacks of particular insect pests and resistant to particular diseases and so forth. In parts of the Central Provinces and Bihar the evolution of purple-pigmented variety has solved the menace of wild rice weed which was indistinguishable from rice. This has led to the saving of lakhs of maunds of paddy. The most serious problem regarding wheat is that of rust which causes widespread devastation to the wheat crop in the country. The Council has been subsidizing research on the control of rust for the last 18 years but the results have unfortunately not yet reached a final stage although a good deal of useful work has been done. Recently a coordinated all-India scheme to check this menace has been worked out and is soon going to be put into operation by the Ministry of Agriculture. In the case of millets and pulses and oilseeds also the Council has done very valuable work. It has also undertaken a number of schemes on soil survey, agricultural meteorology and the manufacture and use of compost on a large scale. Recently the Ministry of Agriculture have started a drive for the use of compost on an extensive scale as part of their 'grow more food' campaign. In agricultural meteorology crop weather calendars have been prepared for each important crop. On this basis the All-India Radio issues daily farmers' weather bulletins.

While the Council could act as an excellent organizing and coordinating agency it was felt that intensive research on the more important crops was also necessary. With this aim in view a number of self-contained commodity committees have been set up by the Government of India which look after research, marketing and development of the more important cash crops. In this series the Cotton Committee is the oldest. It was set up in 1923, even before the Council. Then followed the Jute Committee in 1936. In addition we now have committees for lac, sugarcane, tobacco, oilseeds and coconut and another one for arecanut is soon going to be established. These committees have their own finances and every interest connected with agricultural commodity finds a representation on that committee. Many of these committees have large central and regional stations for research where very valuable work is being done. The Vice-Chairman of the Indian Council of Agricultural Research is *ex-officio* Chairman of all the commodity committees and through him the coordination of research work in all these committees is assured. It is difficult in this short note to give an idea of the many-sided activities of these committees in any detail. Suffice it to say that every aspect of agriculture connected with these particular commodities is looked after by these committees and that they have all done exceedingly useful work.

In addition to the Council of Agricultural Research and the commodity committees there are a number of Central Research Institutes under the Ministry of Agriculture where fundamental research is undertaken. The Indian Agricultural Research Institute which is now located in New Delhi is one of the best of its kind in Asia. Then we have the Indian Veterinary Research Institute at Izatnagar and Mukteswar, the Indian Dairy Research Institute at Bangalore and the Central Rice Research Institute at Cuttack. An Institute for work on potatoes has also been established. An Institute of Fruit Technology is also functioning under the auspices of the Indian Council of Agricultural Research. The Ministry of Agriculture are also contemplating setting up a Soil Conservation and Land Utilization Board which will tackle these all important problems which have hitherto not received the attention they deserve.

Indian agriculture is based on the small field of the poor cultivator and his poor bullocks while in all modern agricultural countries there are mechanized farms. In our country also we have now made a beginning and let us hope that we shall achieve rapid progress in this direction. The Ministry of Agriculture have recently set up a Central Tractor Organization with a nucleus of heavy and small tractors for reclamation and cultivation purposes. This Organization during 1947 reclaimed some 30,000 acres of land and in 1948 undertook cultivation of some 60,000 acres of land in East Punjab and the Matsya Union. One of the Organization's function will be to test out what types of tractors and cultivation implements are suitable under Indian conditions.

From what is said above it will be apparent that the Government of India are alive to their responsibilities in respect of the basic industry of the country and are doing whatever is possible taking their limited resources into account. The outlook for the future is bright and all that we want is more money and more trained personnel.

Original Articles

PLANT PROTECTION IN HOLLAND

By K. B. LAL

LAST July the Government of India deputed me as one of its delegates to attend the Fifth Commonwealth Entomological Conference, held in London. At the expiry of this Conference, the Government of the United Provinces asked me to visit some important centres of agricultural research and development in the United Kingdom, France and Holland and study the methods and organization for plant protection work in these countries. My observations in this connection led me to an examination of the plant protection organization in Holland, which has provided so many points of interest that I need make no apology for describing some of them here. Holland was one of the countries which suffered heavily during the war. It was, therefore, a pleasant surprise to find that the Dutch Plant Protection Service survived all the strain and stress of the war and has emerged out of it with its facilities and functions unimpaired.

Holland is a small country, roughly about one-ninth of the United Provinces in area and one-seventh in population. Yet it has a highly developed system of scientific agriculture. Its agricultural nerve-centre is in Wageningen, a small and picturesque town about 75 miles east of Hague. It is in this town that Holland's Agricultural University is located, which is a training college for all branches of scientific agriculture with about 1,200 students as well as a research centre with 22 Laboratories and four Institutes, spread all over the town, each having its own building and standing in its own grounds. Each is separated from the other by distances, varying from a few hundred yards to a few miles. Distance, however, is no bar to contacts and collaboration among workers, thanks to the liberal provision of telephones, quick, comfortable and cheap bus services, excellent roads and the ubiquitous bicycle.

In addition to the Laboratories and Institutes of the Agricultural University, there are at Wageningen 15 official and non-official Institutes devoted to various branches of agriculture, 10 agricultural associations and the headquarters of various State advisers and Services for agriculture, horticulture, etc. Of these, the Dutch Plant Protection Service is one, which is one of the biggest departments of the Dutch Ministry of Agriculture, Food and Fisheries and directly under its control. The Service is concerned not only with the control of insect pests and plant diseases but also with rats and other rodents, birds of agricultural importance and with malformations and malnutrition in plants caused by deficiencies of various minerals and other elements or compounds in the soil. An idea of its activities may be had from the following brief enumeration of its functions :

1. Inspection of the health condition of bulbs, flowers, potatoes, woody and herbaceous plants, seeds, vegetables and fresh and dry fruits before export and import.
2. Determination of the causes of disease of material submitted for examination.
3. Investigations on method of disease control as well as on sprays and dusts.
4. Advice on the control of plant diseases and on infestation of stored products.
5. Organization for the destruction of rats, mice and harmful birds.
6. Identification of potato varieties. Research on the susceptibility of potatoes to wart disease.
7. Supervision of seed disinfection.
8. Supervision of the control measures against pests and diseases, undertaken by various individuals and organizations.

K. B. LAL is Entomologist to the Government, United Provinces, Kanpur.

9. Multiplication of natural enemies of destructive animals.

10. Publication of reports, pamphlets and communications on plant disease control pests and destructive animals.

11. Supply of preparations, photographs and lantern slides for agricultural and horticultural instructions.

The functions of the Dutch Plant Protection Service are, therefore, not only developmental but also investigational and educational in certain respects and directions and are, indeed, wider in scope and conception than perhaps that of any other Plant Protection Service in the world. The investigational and development work being under the control of the same organization ensures proper coordination between the two activities which is so essential for the progress of both. The development wing throws out the problem for investigation and the research wing works out their solution. Much of the investigational work is done at the headquarters of the Service at Wageningen, which has several large sections for the investigation and handling of various problems. For example, the Service has its own organization for research on deficiency diseases of plants. It has also its own staff for the routine identification of pests and plant specimens damaged by pests and diseases. On an average, the Service receives about 25 to 30 parcels per day, consisting of diseased or pest-damaged plant specimens from farmers and others all over Holland for report, advice or action in respect of control measures. In this way, a close and constant collaboration is maintained between the research worker and the field staff of the Phytopathological Service, the latter throwing out problems for investigation and the former providing their solution.

The Rodents Section is concerned with the study of the biology of different species of rats, mice, etc. the testing of the efficacy and suitability of various rodenticides and with the devising and application of measures of control against rodents not only in the field but also in storage godowns, ships, warehouses, etc. The Agricultural Ornithological Section is unique in being about the only one of its kind, attached to any plant protection service and deals with various problems, both of research and application, relating to the role of birds in agriculture.

The Dutch Plant Protection Service is 50 years old and during this period seems to have justified its utility as a major activity of Dutch scientific agriculture. It has a staff of over 200 men and women, which is, however, only the nucleus of the organization, meant for routine and specialized duties. Much of the extensive work in connection with pest and disease control is carried out with the help of the general agricultural and horticultural staff, who consider plant protection as an important part of their duties.

Under the Dutch law, the control of certain pests and diseases is compulsory, which cultivators must undertake, either themselves or through commercial plant protection firms. If a cultivator fails to undertake control measures against a pest or disease, as required by the Phytopathological Service, by a previously-fixed date, he gets a reminder about it. If he still ignores his obligation, the Service carries out the required measures at the cultivators' expenses. This proves far more expensive to the cultivator than if he had done the work himself or got it done by a firm.

From the foregoing account it would appear that the Dutch Plant Protection Service not only directly undertakes the control of pests and plant diseases of major importance but helps all concerned, both individuals as well as organizations, to do so by providing technical advice, supervision and facilities. In this, however, it does not act merely as a liaison agency, connecting research with its application in the field but also makes itself responsible for the production and collection of the information necessary for growing crops well and for keeping their produce in sound condition. Whatever in the Dutch Plant Protection Service may or may not be applicable to the conditions of India, the important point must be recognized that plant protection in this country, as in others, must be a routine of agricultural activity in which the Plant Protection Service of the country or region may assume initiative, organization and supervision but in which the general agricultural developmental staff must help.

SOME OF THE IMPORTANT FORAGE GRASSES IN THE MURREE HILLS

By H. R. SAINI and H. C. MALIK

THE grasses of the Murree Hills are unquestionably the most valuable crop for these areas. The maintenance of the livestock in these tracts is dependent on the grass crop.

Notwithstanding the great value of grasses to the farmer, it would not be out of place to point out that he knows far less about them than about any other crop or class of crops, which are commonly grown on the farm. The blame for such lack of knowledge cannot however be placed at the farmer's door because he has not inherited any experience in this respect. His forefathers did not pay any attention to the cultivation of grasses as they occurred in plenty in their time, and it is only recently that the cumulative effect of long continued indiscriminate over-grazing, resulting in an extreme deterioration of the grazing areas, has forced attention towards this most important subject.

It is not surprising, therefore, that the average cultivator knows only a few grasses that are found in his locality. They are probably half a dozen in number. But in regard to some of these even he has never learned the full value and methods to stimulate greater production. Such for instance are *Dholu* (*Chrysopogon montanus*) and *Suryala* (*Heteropogon contortus*), etc. which are abused by over-grazing and are neglected.

The aim of the present article is to discuss some of the important grasses, which are really worthy of cultivation and management in the Murree Hills.

Four species deserve special mention. These are *Suryala* (*Heteropogon contortus*), one of the most commonly found high yielding grasses of great feeding value; *Palwan* (*Andropogon pertusus*); *Dholu* (*Chrysopogon montanus*); and *Khabbal* (*Cynodon dactylon*). There are also other species of grasses such as *Loonder* (*Anthisiria anathera*), and *Maniara* (*Pennisetum orientate*), which occupy the second position with regard to their importance.

Besides these there are exotic grasses, viz. Giant-star grass, *Paspalum dilatatum*, and Rhodes grass, all of considerable value, but of lesser importance to the farmers of the Murree Hills.

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Heteropogon contortus

Heteropogon contortus is commonly known as *Suryala* on account of its ripe seeds having pointed needle-like ends (*Suryals*).

The plants tiller profusely and may have 30 to 40 tillers, which grow usually to a height of 30 in. to 37 in., but may attain a height of 4 feet. When in full bloom, an enclosure of this grass is an attractive sight. The leaf growth cannot be said to be large in proportion to the stems (leaf-stalk ratio 8 : 13), but it is one of the best grasses of the Murree Hills, and gives grazing in the early season. The grass is highly palatable in young stages, i.e. before the ripening of seed.

Suryala is a perennial grass and under favourable conditions will grow a number of crops in succession, but under unfavourable conditions, it is short-lived. It is fairly leafy, with fine culms and the leaves are 25 to 30 cm. long and 2·4 cm. broad, being fine and smooth in the younger stages, but becoming coarse at maturity.

This grass is adapted to a wide range of altitudes from 2,500 ft. to 7,000 ft. above sea-level, but grows luxuriantly in the upper hills under moist conditions only.

Soil : The grass will grow equally well on a wide range of soils, and there is probably no soil in the Murree Hills in which it will fail to establish itself, if the climatic conditions are suitable. Nevertheless, to grow it at its best, the soil should be rich and moist, and fairly well-supplied with humus. The more the soil is enriched, the better will be the growth that will follow.

Sowing : Seed is either sown in spring or during June and July. If moisture is available, spring crop is assured from seed, while planting from rootstocks succeeds very well during rains.

The seed may be sown broadcast taking care that it is not buried deep. Seed sown with the first showers of rain enables the plants to get established well, before the severe cold sets in. When sown alone 5 to 6 lb. seed is enough for an acre, but in some cases 8 lb. will be found necessary. When the grass is propagated from vegetative parts 5,000 to 6,000 rootstocks are enough to plant an acre ; but it is preferable to sow it from seed, because good quality viable seed is formed in this grass.

Pasturing : The bulk of the growth for the season takes place during monsoons within a period of three months, July, August and September ; but the newly sown crop establishes a good pasture in two to three years. The plants are highly relished just at the time the flowering starts and they should be cut with the first opportunity after the rains, because if left over to mature, the needles of the seed reduce their utility to a considerable extent.

Although it stands pasturing well when conditions for growth are generally favourable, close grazing will cause it to fail within a few years. For this, doubtless lack of moisture will in part be responsible, but in certain cases it will fail under close grazing even when moisture is enough.

Harvesting for hay : In order to secure the highest feeding value in the grass, it is necessary to cut it while yet immature, viz. when in the second bloom stage.

Well-established grass gives two cuttings. Spring sprouting is ready for harvest in June, and the second growth can be cut in September. It is a fairly high yielding grass, and can give 30 to 35 md. of hay per acre.

Andropogon pertusus

Andropogon pertusus is locally known as *Palwan* grass and consists of several varieties out of which two are of importance. One has spreading habit with only flowering culms erect, while the second is of a bushy type. The former is a good pasture grass, for it stands grazing well because of its spreading nature and stout stubble. The other type is an excellent hay grass and is highly commended for its feeding value.

Both are high tillering and as many as 127 tillers have been observed on an average on good soils with plenty of moisture. The plants attain a height varying from 40 in. to 55 in. The grass is leafy with leaves 53·5 cm. long and ·6 cm. broad. The leaf-stalk ratio is 57 : 46, which indicates that there are more leaves than stalks.

Palwan is a perennial grass, and is found both in the plains and in the hills, and is, therefore, adapted to a very wide range of climatic conditions. It, however, prefers rich soils, with abundance of moisture.

Soil : It is adapted to many kinds of soils, but the best conditions for its growth are found in clay loam. It, however, does not grow well in sandy soils with but little clay in them.

Preparation of the soil : This will vary with the soil and climatic conditions. Light soils are prepared easily to form a fine seed bed to secure good germination of the seed. Loam soils, however, require more pulverization, but where rainfall is abundant and well-distributed, as in these Hills, fine pulverization is not so necessary. It is not usual to fertilize lands where this grass is to be sown.

Sowing : The grass is usually raised from rootstocks, as it is very difficult to secure well-matured seed in large quantities. About 6,000 rootstocks are enough for an acre when planted at distances of about 2½ ft. to 3 ft. each way.

The seed rate varies with the soil and climatic conditions. When sown alone on good soils, it is seldom necessary to sow more than 10 lb. per acre.

Pasturing : The grass establishes itself very quickly. Generally speaking, grazing closely when the plants are young does not injure this grass as in the case of other grasses. Grazing on unduly wet soils, however, is to be avoided.

In order to get the maximum amount of grazing from this grass, it should not be grazed very closely. The grass thus managed and left ungrazed in the spring provides excellent summer and autumn grazing.

Harvesting for hay : Palwan grass being more a pasture than a hay plant, is not usually made into hay. It is not sufficiently bulky, hence the yield per acre is not high. But this does not mean that it cannot be harvested for hay.

Fully matured grass, harvested in September, yields on an average 25 md. of dried grass per acre.

Chrysopogon montanus

Dholu grass (*Chrysopogon montanus*) is also known by the name of *Chita* (white) grass due to the whitish colour of its stalks. The stem is strong and usually grows to a height of 3 to 4 feet, but under favourable conditions may even reach 5 feet. Culms are tall, glabrous and cylindrical, with small leaves above and long leaves below. The panicle is beautifully conical or ovate in shape, frequently with purplish spikelets, borne in whorls on delicate branches. The grass is considered to be an excellent fodder.

It is perennial, and quick-growing and can give more than one cutting during the season. It is usually found in the lower hills up to an altitude of 3,500 ft. above sea-level. The grass flourishes well in well-drained shallow, sandy or stony soils. On heavy soils the grass remains stunted and is ousted by other grasses.

Dholu has the habit of growing in bunches or tussocks, unless thickly sown; hence the aim should be to sow it thickly so as to prevent this when grown for pasture; otherwise it should be grazed so closely that these tussocks will not over-shadow other grasses, which may be growing among them, to the extent of destroying the latter.

The grass on an average grows to a height of 3 feet. It has a medium tillering capacity, 44 tillers per plant being not uncommon. The plants are fairly leafy, the leaf-stalk ratio being 21 : 20.

The grass cannot be grown at altitudes above 3,500 ft. It grows more successfully under moderately moist conditions, but once established, it can continue under somewhat dry conditions also.

Soil : In the Murree Hills the grass is found in shallow, sandy or stony soils which are not subject to water-logging.

Dholu grass is propagated through seed as well as rootstocks. It is, however, difficult to get an established enclosure of this grass through rootstocks, because of the high mortality of the new plants under dry land conditions. About 6 to 8 lb. seed is enough to sow an acre. It gives fairly satisfactory germination, and seedlings make quick growth.

The best time of sowing this grass is with the break of monsoons, but in order to secure satisfactory germination, the seed should be soaked in water for at least two hours, and then rubbed with moist earth, before it is broadcast. Efforts should be made to sow the seed evenly to avoid patchy growth.

Pasturing : The grass, sown with the first shower of rain in the months of June and July, is ready for cutting in September, but well-established pastures are formed after a period of three years. It is advisable to avoid pasturing in the first year. Well-established pastures can be cut twice in the growing season from June to October. The grass, however, should be harvested at the flowering stage when it is highly nutritious.

Harvesting for hay : As the grass is highly nutritious at the flowering stage, it should be cut for hay with promptness at this time. Yield of hay varies, but 25 md. of hay per acre can be obtained from fully established meadows. The grass is, however, very succulent and not very suitable for conversion into silage.

Cynodon dactylon

Cynodon dactylon (*Khabbal* grass) is also known by the name of *Dub* grass. It is a creeping perennial grass, and each node is capable of producing a new plant, though completely separated from all others. Under favourable conditions these stems may grow 12 to 15 feet in a single season. It also produces rhizomes at a depth of 4 to 5 inches and extending laterally several feet. The creeping stems are numerous with ascending or upright leafy branches, from 4 to 10 inches in height. It has two or three or even four leaves to a joint. When in bloom it has 3 to 4 digitate spikes borne on the top of each flowering shoot. The leaves are flat gradually tapering to a slender acute tip.

The grass when once established is difficult to eradicate, and serves as one of the best plants to check soil erosion. It loves hot climate and good soil, and can stand drought admirably. Though apparently dead due to drought and cold, it will revive very quickly when moisture is available. The grass is beyond question the most valuable pasture grass and furnishes more and better grazing than any other grass. It is liked by all kinds of livestock, and makes excellent hay.

The grass is found both in the hills and in the plains, but cannot endure the severe cold of the high hills.

Soil : It thrives on almost any kind of soil but, of course, not equally well. Best growth is secured on rich soils of alluvial character. It also tolerates considerable alkali in the soil, and makes good growth with the application of farmyard manure. Rich soils free from other grasses suit best.

It is propagated from rootstocks in preference to seed, as the latter is very small and has very low viability. Moreover seedlings grow rather slowly and other grasses and weeds overwhelm them.

The more common method is to plant roots 1 to 2 ft. apart in furrows, which may be pressed by feet or covered by *sohaga* (plank leveller). Planting in this way is best done when the weather is moist, as it ensures the sprouting of the roots.

Pasturing : Dub grass forms an excellent pasture, but stems become rather tough and wiry with age. The forage is palatable and of high nutritive value. It is so aggressive in growth that few other plants will grow with it during summer. One acre of grass will maintain one cattle during the growing season. Though close grazing is usually avoided in other grasses, this grass can be grazed somewhat closely during the growing season.

It is a very good feed for cattle and sheep, and is considered an excellent one for horses.

Harvesting for hay : The grass is cut for hay when it is in full bloom, but the number of cuttings depend upon the soil and weather. As many as four cuttings may be obtained, each yielding from 15 md. to 20 md. of hay per acre. Yield of hay, however, is increased considerably if the soil is manured.

Anthistiria anathera

Anthistiria anathera (*Loonder* or *Bari*) is one of the most familiar and popular grasses of the tract so much so that at some places it has been observed to form as much as 80 to 90 per cent of the grass enclosures. Its percentage increases with the altitude and it is most common at a height of 5,000 ft. above sea-level.

It is a perennial grass of gregarious habit and grows to about 4 ft. usually growing erect, but sometimes the culms are decumbent at the base. The stalks are quite slender, slightly compressed, glabrous and soft to start with, but become fibrous and hard as growth advances. They become so coarse and stiff at maturity that they are used for making brooms, and it is due to this that the grass owes its name of *Bari* grass.

The leaves are long and narrow, measuring 25 to 30 cm. in length, and 2 cm. in breadth. They are smooth and fine in the young stage, but become fibrous at maturity.

The inflorescence is an elongated lax panicle with a large number of branches at each node.

Soil : The grass is very hardy and can grow where no other grass can survive. It can stand shade better than other grasses of the tract, and usually dominates in shady spots on the northern slopes of the ridges. It has also been seen making fairly good growth even under the litter of pine needles, which is fatal to the growth of other grasses. *Loonder* resists frost best of all and can be grown on all types of soils and under a very wide range of altitudes.

In the young stage, when flowers begin to appear, the grass is eaten with great avidity, but on maturity the stalks become coarse and unpalatable. It should, therefore, be cut as soon as rains cease and the panicles are out.

Sowing : It is propagated both by means of seed and rootstocks. About 8,000 rootstocks are enough to plant an acre, when planting is done at distances of 2 ft. each way. It is, however, economical to propagate this grass through seed, because it is very difficult to plant and establish rootstocks on the slopes of hills. Eight to ten pounds of seed is enough to sow an acre. Under natural pasture conditions in the hills, seed should be soaked in water for a couple of hours before broadcasting. Seed germinates within 72 hours during rains in July. The young plants establish themselves in the first year, and are ready for harvesting or grazing in the next monsoon.

The growth and yield is very low in the first year and gradually increases till the fourth year, when heavy turn-outs are available. Eighteen to twenty maunds of hay (dried grass) has been obtained per acre.

Pennisetum orientale

Pennisetum orientale (*Maniara* grass) is a perennial grass. The stem is fine and thin before flowering, but inclines somewhat to coarseness, unless when the plants grow thickly.

It usually grows to 3 to 4 feet high, but under favourable conditions may reach 6 feet. The leaves are long, measuring about 100 cm. in length and approximately 1·25 cm. in breadth. The panicle is solitary and the spikelets are frequently tinged with purple. The leaf-stalk ratio of this grass is 22 : 20. The roots are fibrous and go down deep into the soil.

It is one of the good fodder grasses, but it is not of gregarious habit. It grows solitary on the bunds of cultivated terraces or near the bases of rocks where water cannot stagnate.

The grass is of two kinds, differing in the habit of growth and size of leaves. One has broad and fine leaves and less gregarious habit, while the other has coarse and narrow leaves and gregarious habit. The former is preferred for grazing.

Soil : Soils with good drainage are the best for the growth of this grass.

Sowing : The grass is usually propagated by rootstocks, which are planted at distances of 1½ to 2 ft. each way. In all 6,000 to 8,000 rootstocks are enough to plant an acre. It is also sown from seed, but seedlings die off in large numbers during the rains. About 8 to 10 lb. seed per acre is enough. The best time of planting or sowing seed is with the break of monsoon during June-July, and it is always better to plant it from roots.

Pasturing : The grass makes good growth and gives fairly heavy yields. Individual plants at maturity have been found to weigh as much as 2 to 3 lb. Well-established mature grass yields 30 to 35 md. of hay per acre.

The yield is very low during the first year, but is very high when it is well-established, i.e. in the two succeeding years. Only one good cutting is obtained during September-October.

In addition to the above-mentioned local grasses, experiments are under way with some grasses of foreign origins, e.g. Rhodes grass (*Chloris gayana*), *Paspalum dilatatum* and Giant-star grass. These appear to be promising and of great value for grazing and hay.

WHEAT AND FERTILIZERS FROM RUSSIA

UNDER an agreement signed with Russia India will receive 81,000 tons of Russian wheat in exchange for 5,000 tons each of jute and tea, and 1,000 tons of castor oil. In addition India is purchasing 20,000 tons of Russian wheat.

Negotiations have been completed for obtaining 40,000 tons of sulphate of ammonia from U.S.S.R. When received, this fertilizer will be allocated to Provinces as follows : Bihar : 4,250 tons ; Bombay : 5,000 tons ; Central Provinces and Berar : 4,000 tons ; United Provinces : 1,500 tons ; Madras : 8,700 tons ; West Bengal : 3,400 tons ; East Punjab : 1,800 tons ; Coorg : 500 tons ; Hyderabad : 2,000 tons and Assam : 350 tons.

A reserve of 2,500 tons will be kept with the Centre to meet *ad hoc* demands.—*Food Bulletin*, February 14, 1949.

TRANSPORT OF MIRROR CARP FROM OOTACAMUND TO KUMAON HILLS

By B. SUNDARA RAJ and R. P. CORNELIUS

THE common carp (*Cyprinus carpio-karpfen*) is originally a native of China where it abounds in a wild state. It was introduced into Europe in the thirteenth century. Under domestication in Europe two well-known varieties of the common carp have been evolved. One of these is called 'Mirror Carp' (*Spiegelkarfen*) and is distinguished by its extraordinarily large scales of great reflective power arranged irregularly on the body, and the other is called the 'Leather Carp' (*Lederkarpfen*) which is practically devoid of scales. The fully scaled common carp and the above-mentioned two varieties were introduced from Germany in the upland waters of Ceylon in 1914, where they are well-established and are fairly abundant. From Ceylon they were brought to the Nilgiris (South India) by the senior author of this paper in 1939. Like most hill waters above 4,000 ft., the Nilgiri plateau had no indigenous food fish of any importance. The introduction of the Mirror Carp has proved great success and has solved the problem of a food-fish fishery for the Nilgiris. They grow rapidly to a large size and breed so profusely that the Madras Government constructed a special market and farm at Ootacamund in 1946 for the sale of this fish from the Ootacamund Lake.

It was, therefore, decided that this fish would solve the problem of establishing a food-fish fishery in the Kumaon Hills of the United Provinces. Special arrangements had to be made for the transport of the fingerlings of Mirror Carp from Ootacamund to Kumaon. A special oxygen container was designed by the senior author.

Description of the container

A petrol tank of 10 gallons capacity made of galvanized sheeting measuring 21 in. × 8·5 in. × 11·75 in. was selected for this purpose (Fig. 1).

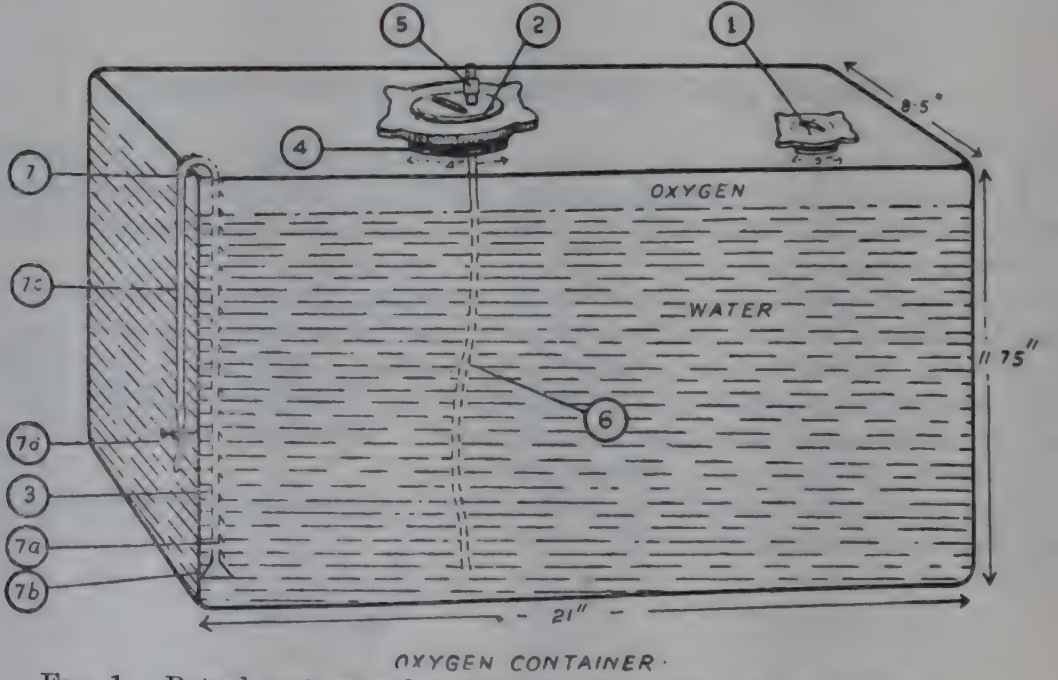

FIG. 1. Petrol tank of galvanized sheeting with oxygen container.

In addition to the original small 2 in. opening (1) with an air-tight screw cap, a larger opening of 4 in. diameter with a similar cap (2) was provided to facilitate the introduction and

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removal of fish as well as to enable proper cleaning of the container and screening of the inside opening of the outlet tube (3). Fibre washers (4) well-impregnated with wax were found air-tight and convenient. For introducing the oxygen a bicycle valve (5) is fitted to the bigger screw top to which a 9 in. long valve tubing (6) is attached so as to reach almost to the bottom of the container. This is an additional precaution to prevent leakage of the gas through a defective valve during transit. At the corner of the container a U-shaped brass tubing (7) 0·25 in. in diameter is welded to the tank inside and outside. The inner end (7a) of the tube extends down to ½ in. from the bottom and has a funnel-shaped end (7b). This is for fixing a net or cotton wool to prevent the escape of fry if they have to be carried. The outer end (7c) extends only to two-third the height and ends in a tap (7d). This tube when open serves as an outlet for water when oxygen is introduced into the closed tank.

Experiments

Experiments were carried out both on the plains and at Naini Tal to test the capacity and efficiency of the container. The container was found suitable for about 60 fingerlings ranging in size from 1½ in. to 2½ in. for a period of 48 hours. The number and size of fish which could be conveniently carried, the quantity of oxygen needed and the time for which fish (carp) could be kept alive in the container were experimentally ascertained before the container was used for the long distance transport. An experiment was also performed with complete success by the junior author at Ootacamund with fingerlings of Mirror Carp before the actual transport by air was undertaken.

Use of the container

The tank is filled with clean fresh water and fish up to the very top, leaving no air space. The screw top is then tightly screwed on with its waxed washer (when the wax is still hot and liquid) to make it completely airtight. Oxygen is then introduced slowly through the valve (5) and the quantity of water displaced through the outlet syphon (7) is measured. After about a gallon of water has been displaced, the tap attached to the outer opening of the syphon is closed to prevent leakage of water or oxygen by accidental tilting in transit. The jolting during transit helps to dissolve the oxygen in the water and keep it aerated for the fish.

Oxygen contents of the water in the container

On the plains water at a temperature of 82° to 85° F. was found to hold only 2·6 parts of oxygen per million parts of water. After 24 hours in the container with fish the oxygen content was found to be 2 p.p.m. and after 31 hours only 1·5 p.p.m. The transport from Madras to the Kumaon took 31 hours. According to Prof. Plehu, carp in Germany live well in water with 5 c.c. dissolved oxygen per litre or 7·142 p.p.m.

Refrigeration of the container

For the transport of Mirror Carp from Ootacamund at an elevation of about 7,500 ft. with water temperature about 55°F. in July, it was necessary to refrigerate the container with crushed ice and saw-dust (Fig. 2). The container with fish and oxygen was packed in a tin-lined wooden case (Fig. 2) with crushed ice and saw-dust all round the container.

Transport of Mirror Carp in the oxygen container

The actual transport of the Mirror Carp was done by the junior author. On 27 July 1947, sixty fingerlings of Mirror Carp ranging from 4 to 5·6 c.m. including two of 8 and 8·4 c.m. respectively were placed in the oxygen container at 11.00 a.m. at Ootacamund with water temperature of 55°F. and the container was brought by express train from Ootacamund to Madras. When the train descended to the plains at Mettupalyam at 5.00 p.m. ice packing was done with 50 lb. of ice. When the fish arrived in Madras the next day at 7.5 a.m. they were all alive. They were taken to the Fresh Water Biological Station, Chetpet, and were released into a shallow round earthen tub 3 ft. in diameter and 10 in. high with water kept cool at 55°F. with ice all round. Some *Vallicenaria* and *Hydrilla* were put in the tub to provide shelter to the fish. For the sake of comparison 50 fingerlings of the same size were also brought the same day and by the same train in an ordinary tin carrier from Ootacamund to Madras with an ice bag round it.

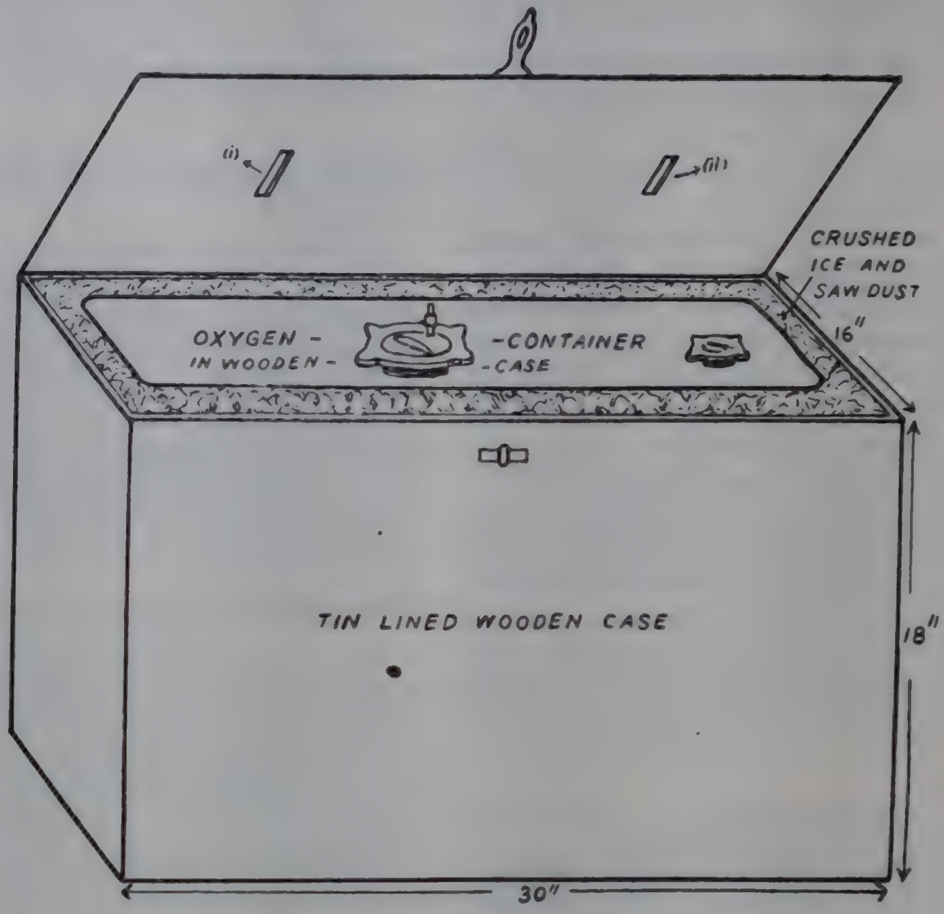

FIG. 2. Tin-lined wooden case with oxygen container.

Among these there were four casualties which points to the superiority of the oxygen container.

After 18 hours of rest in Madras (necessitated by the arrival of the train after the departure of the plane on 28 July) at 4.00 a.m. on 29 July, 1947, the sixty fingerlings from the refrigerated earthen pot were repacked in the oxygen container with 50 lb. of crushed ice as before and were taken by aeroplane leaving Madras for Delhi at 6.30 a.m. After a halt of about half an hour at Hyderabad-Deccan, Nagpur and Bhopal, the plane arrived at Delhi at 4.30 p.m. The consignment was taken to Delhi Junction and booked by express train which left Delhi at 6.45 p.m. and arrived at Bareilly at 4.30 a.m. on 30 July, whence it was taken by motor to Bhowali hatchery at an elevation of 5,000 ft. and released in active and healthy condition in a specially prepared pond at 11.30 a.m.

Conclusion

To facilitate fish transport, oxygen has been used in many countries and there are many types of oxygen containers in use. The purpose of this paper is to bring to the notice of all those interested in fish transport, a sealed and convenient type of oxygen container which is easy to handle and is capable of withstanding exigencies of transport with special safeguards against leakage of water and gas. The successful transport of fish without a single casualty speaks for the efficiency of the apparatus.

CAULIFLOWER SEED PRODUCTION

By TARA SINGH RUALA

IT is now a common knowledge that vegetables are a very cheap and good source of vitamins and mineral matter which are essential for keeping the body in a fit and healthy condition. To improve health of a nation it is essential that vegetables should be available abundantly and at a reasonable rate so that every individual can afford to include these in his daily diet. The present production of vegetables in India is reported to be about half of what is desired by the nutritional experts. The production has, therefore, to be doubled.

The most important factor in the production of vegetables is the supply of good quality seed at a reasonable rate as the success in vegetable farming depends to a very large extent on the availability of reliable seeds. Unfortunately, not much research work has been done on the production of vegetable seeds with the result that no one can say definitely as to which method is the best for any crop with regard to yield and quality of the seed. Various methods for the production of seed of cauliflower are in vogue in India, but no investigations have so far been carried out to assess the real value of each. The research work was, therefore, undertaken by the writer with a view to ascertain the comparative merits and demerits of various methods of seed production of cauliflower.

Common method

The most common method followed in India for the purpose of seed production is that from a cauliflower field desirable heads are selected and plants are dug out with balls of earth sticking to their roots and transplanted to a convenient place to mature the seed. The advantages claimed for this method are as under:

1. The field can be vacated earlier for putting in another crop.
2. The selected plants can be easily protected from unseasonable weather, i.e. either severe frost or extremely hot weather.
3. The plants can be given better cultural attention.
4. More rigid selection of the plants of the desirable type can be made.

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The disadvantages of this method of seed production are as follows:

1. Extra labour is required for the transplanting operation.
2. Some plants die and are, therefore, lost.
3. The continuous growth of the plant is interrupted owing to injury to the roots during the operation of transplanting which results in lower yield of the seed.

The practice of allowing the plants to mature seed *in situ* is not considered desirable by the growers in India owing to the belief that seed produced by this method is of poor quality in respect of germination and production of curds. This method is, however, generally adopted in Australia and other countries and is considered to be the best method for the production of seed of cauliflower.

A few growers produce seed of cauliflower by transplanting mature plants but no effort is made to retain any soil sticking to their roots. They consider that by this method seed of good quality is produced. The extensive root system of cauliflower plants is injured when the plants are transplanted, and especially so when they are transplanted without balls of earth. The plants, therefore, do not make much progress and give lower yield of seed which is also poor in germination as compared to the seed produced from plants transplanted with balls of earth.

Stage of maturity of the heads at the time of transplanting is another important point. Some growers prefer to take out plants for transplanting when the heads have sprouted, while others perform this operation when the heads are compact. But no study has so far been made with a view to find out the most desirable stage of development of the heads at the time of transplanting.

Various methods of seed production

Transplanting mature plants versus in situ: The comparison of non-transplanted plants with those transplanted with balls of earth shows that the former gave a much higher yield of seed than the latter. From Table I it will be seen that the yield of seed obtained from plants allowed to remain *in situ* was more than six times the yield got from transplanted ones. Germination of the seed was also slightly better.

TABLE I

Germination and yield of seed from transplanted and non-transplanted plants

Year	Average yield of seed (in gm.)		Average percentage of germination	
	Transplanted plants	Plants *in situ*	Transplanted plants	Plants *in situ*
1944–45	52·3	406·1	83·5	89·0
1945–46	116·0	750·8	83·7	91·3

The results can be attributed to the fact that the highly developed root system of cauliflower plants receives a serious set-back when plants are transplanted, as most of the roots are damaged. According to Weaver and Bruner (1927) root system of a mature plant of a cauliflower fully occupies the soil 1½ to 2½ feet laterally and at least 3 feet deep. The operation of transplanting damages most of the roots, thereby interfering with their efficient working which is essential for the normal growth of the plants.

The belief of the growers that curds from the seed obtained from non-transplanted plants are of inferior quality was also found to be erroneous. The heads raised from the seed produced by the two methods were compared and it was found that heads raised from seeds produced from non-transplanted plants were not in any way inferior to those raised from seeds obtained from transplanted ones as given in Table II.

TABLE II

Comparison of heads produced from seeds of transplanted and non-transplanted plants

Method of seed production	Average size of head (in sq. cms.)	Average No. of days required from sowing seed to the maturity of the head	Percentage of plants that produced good head
Transplanted plants	592·7	104·2	72·9
Plants *in situ*	589·5	103·5	77·1

It should, however, carefully be noted that if seed is to be raised from plants allowed to remain *in situ* only plants with desirable heads should be allowed to produce seed. All plants which have undesirable heads should be taken out before they give out floral shoots in order to prevent crossing of superior plants with the inferior ones.

Transplanting plants with and without balls of earth : In case, however, it is necessary for some special reasons to transplant plants to some other place the plants should be taken out with balls of earth sticking to their roots so that as little root system as possible is damaged. The comparison of the plants transplanted with and without balls of earth has shown that higher yield of seed was obtained from the former method. The results obtained show that plants transplanted with balls of earth gave a higher yield of seed which was also better in germination.

TABLE III

Performance of plants transplanted with or without balls of earth

Year	Average yield of seed (in gm.)		Average percentage of germination	
	Transplanted with balls of earth	Transplanted without balls of earth	Transplanted with balls of earth	Transplanted without balls of earth
1944–45	44·2	12·2	87·7	74·0
1945–46	102·5	55·1	92·8	79·0

The yield of seed obtained from plants transplanted with balls of earth was more than double than that obtained from plants transplanted without balls of earth. It is therefore clear that if for certain reasons plants are to be transplanted, they should be taken out with balls of earth sticking to their roots.

Stage of development of the head at the time of transplanting : The growers generally transplant cauliflower plants with compact heads for the production of seed. A study of the different stages of maturity of the head at the time of transplanting has shown that sprouted heads produced a higher yield of seed which was also much better in germination as compared to the compact heads and heads just beginning to break. The results are given in Table IV.

TABLE IV

Production of seed from plants with sprouted and compact heads at the time of transplanting

Stage of maturity of the head at the time of transplanting	Average yield of seed (in gm.)		Average percentage of germination	
	1944-45	1945-46	1944-45	1945-46
Compact heads	41·1	119·3	74·2	70·2
Heads just beginning to break	51·1	133·4	75·5	72·5
Heads with sprouts 1 to 2 inches	88·0	220·3	79·5	78·0
Heads with sprouts above 2 inches	110·2	165·5	89·5	82·5

It is clear from the figures that plants that have produced sprouts should be preferred for transplanting for the purpose of seed production.

Number of floral shoots allowed to mature seed: Investigations were also taken up to find out the effect of thinning of floral shoots on the production of seed. The data obtained are recorded in Table V.

TABLE V

Effect of thinning of floral shoots on seed production

Number of floral shoots allowed to mature seed	Average yield of seed (in gm.)		Average percentage of germination	
	1944-45	1945-46	1944-45	1945-46
100 per cent	100·2	128·1	82·0	76·5
75 per cent	126·7	89·2	92·2	81·0
50 per cent	66·6	86·7	92·7	84·0
25 per cent	38·1	76·0	93·2	90·5

The results show that 100 per cent and 75 per cent floral shoots gave a decidedly higher yield as compared to the other two treatments. On the other hand the seed produced from 25 per cent floral shoots gave the highest germination while the seed obtained from 50 per cent and 75 per cent floral shoots was also superior in this respect to the seed produced from plants in which all the floral shoots were allowed to mature seed. It is, however, clear that the best method from the economic point of view is to allow all the floral shoots to mature seed. In case, however, the plants are making luxuriant growth it may be advantageous if a light thinning of the less vigorous floral shoots is resorted to.

Conclusion

In conclusion, it may briefly be stated that the method of allowing a cauliflower plant to mature seed *in situ* is the best as it gives much more yield of seed as compared to that obtained from transplanted ones. The progeny raised from this seed is also not in any way inferior to that raised from seed obtained from transplanted plants. Of course, only plants with desirable heads should be allowed to mature the seed. If, however, for some special reasons it becomes necessary to transplant the plants they should be taken out with balls of earth sticking to their roots so that the roots are injured the least. The transplanting of plants should be done when the heads have given out sprouts.

GREEN MANURE

By T. J. JOHN

IT is now recognized that one of the most effective measures to increase the yield of paddy is the intensive application of green manure to paddy crop.

Nitrogen which is very essential for plants is contained in green manure in a large measure. The application of green manure tends to increase the humus in the soil which has got the peculiar power of binding sandy soils and imparting looseness to sticky and heavy clay soil. But the chief merit of green manure lies in its usefulness in reforming alkaline soils.

Conversion of green manure

Decomposition of green manure converts much of the plant matter into carbon dioxide which either passes into the air as such or combines with water in the soil to form carbonic acid. This acid converts more or less various soil minerals into forms which plants can utilize. Other parts of the green manure are converted into ammonia which remains in the soil and through bacterial action is converted into nitrates. Hence, larger the percentage of nitrogen in the plants buried, the greater will be the quantity of nitrates. When the content of nitrogen is low, bacteria may use all of it for their growth. However, when they die and decay they give their nitrogen back to the soil. When the quantity of nitrogen is very low, as in straw, harmful effects may result from an application because bacteria may take their nitrogen from the soil and actually compete with plants being grown.

Economical dose of green manure

Hence, it is advantageous to have a fair knowledge of the right economical dose of green manure having regard to its nitrogen content. The percentage of nitrogen in green manure at any time is influenced by three important factors, namely moisture content, the age of the leaves and the proportion of lignified to proteinaceous tissues. The result of analysis of some of the ordinary green manures generally used in South India in respect of nitrogen are given in the following Table published by the Travancore Agricultural Department.

TABLE I

Nitrogen content of certain green manures

Variety of manure	Nitrogen percentage of green material
1. *Avarum* (*Cassia auriculata*) ...	2·10
2. *Vrali* (*Dodona viscosa*) ...	1·72
3. *Boga* (*Tephrosia cardida*) ...	1·72
4. *Konnai* (*Cassia florida*) ...	1·60
5. *Pongu* (*Pongamia glabra*) ...	1·54
6. *Erukku* (*Calotropis gigantea*)	1·49
7. *Vahai* (*Albizzia lebbek*) ...	1·33
8. *Portia*	1·05
9. *Margosa*	0·80
10. Wild indigo	0·78
11. Sunn hemp	0·75
12. *Dhaincha*	0·62

From a study of this Table one can easily judge that 2,000 lb. of *Avarum* green manure is equal in nitrogenous value to 2,500 lb. of *Vrali* or 3,000 lb. of *Erukku* or 4,000 lb. of sunn hemp.

Two types

Green manure generally cultivated as cover crops are of two classes: nitrogen gatherers, those that fix atmospheric nitrogen from the air in the soil and nitrogen consumers, those that cannot perform this function but use what nitrogenous compounds are already in the soil. The principal nitrogen gatherers are the leguminous plants. These plants on their roots develop nodules harbouring nitrogenous bacteria which are capable of making use of free nitrogen in the atmospheric air in the soil to prepare nitrogenous substances useful for plants. When the nitrogen gatherers are dug or ploughed under, they add important quantities of nitrogenous material to the soil as well as other

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organic compounds; when the consumers are similarly treated they add no plant food but what they took from the soil, no nitrogen but what they were able to save from loss.

Ideal green manure crop

Among the many kinds of green manure crops *Pillipesara* (*Phaseolus trilobus*) is recognized as the best. It grows well in all kinds of soil. If there is summer rains, the foliage is so luxuriant that the crop sown in one acre would be sufficient for using in two acres. It is very easy to be ploughed in and decomposes quickly. Its vines can be cut and fed to cattle. It gives abundant quantity of seeds, which also form a good substitute for cotton seed as fodder for cattle.

Paddy plant takes the nitrogen needed for it in the form of ammonia. When green manure is added at the time of puddling, that is just before sowing or transplanting, large quantity of ammonia is produced as a result of its decomposition, which is very useful for the growth of the plants.

Green manure and bonemeal

When considering green manure, it is necessary to mention bonemeal because they are so much indispensable to one another. When one of them alone is used the results are not so marked. They form a very good combination and very startling results have been observed by using them together. Ryots sometimes apply bonemeal after planting. This is wrong. To give the maximum effect it should be applied with green leaves at the time of puddling.

Stable manure

Unquestionably, the best of all fertilizers is stable manure because as it decays it supplies not only all its mineral elements but nitrogen and humus. It is in partially digested form and is full of micro-organisms which help to unlock other plant foods held in the mineral compounds of the soil. With a liberal dressing say 100 to 150 lb. of dry stable manure in 1,000 sq. ft., small quantities of artificial manures also may be added but it is advisable not to use artificial manure alone in the field.

Nitrogen and phosphoric acid are two of the most important plant foods and the ratio in which they are to be applied depends on the nature of the soil. In places where plants generally have a rank growth nitrogenous manure is not necessary but superphosphates can be added; sulphate of ammonia can be added to the soil where plants do not have such marked growth. Generally 100 lb. of the former per acre and 50 lb. of the latter per acre can be applied a month after sowing or transplanting.

It is gratifying to note that as an incentive to agriculturists to grow more food crops, the Government is considering the proposal to allow ryots to gather green manure from reserved forests and to distribute free green manure seeds to enable them to grow green manure crop between June and September so that the green leaves could be ploughed into the land for the *sambha* crop in September-October.

The Indian farmer has yet to learn the right kind and quantity of manure for the soil and for the crop he raises on his farm.

CULTIVATION AND EXPORTATION OF DUTCH SEED POTATOES

By J. A. HOGEN

DUTCH seed potatoes are successfully exported to many countries. Pre-war buying countries in the order of the volume of their imports included Belgium-Luxemburg, France, Germany, Italy, Switzerland, Spain, Portugal, Brazil, Argentina, Great Britain, Egypt, Czechoslovakia, Bulgaria, Yugo-Slavia, Latvia, South Africa, Dutch Indies, Venezuela, while Palestine, Gibraltar, Turkey, Syria, Portuguese East Africa, Morocco, Tunis, Algeria, Congo, and Siam were purchasers of far less appreciable quantities.

The Graph illustrates the development of these exports which have, since 1929, shown a marked increase. The exportation of 350,000 tons in 1946 which, indeed, was an all-time high, is indicative of the rapid recovery of the agriculture of the Netherlands from the effects of the war.

The importance of the seed potato cultivation in the Netherlands is reflected in the following survey showing the hectarage* under seed potatoes over a number of years.

1933 — 17·924 ha.
1934 — 12·390 ha.
1935 — 14·434 ha.
1936 — 17·169 ha.
1937 — 22·405 ha.
1938 — 23·698 ha.
1939 — 23·064 ha.
1940 — 17·600 ha.
1941 — 24·335 ha.
1942 — 34·051 ha.
1943 — 43·804 ha.
1944 — 40·500 ha.
1945 — 32·747 ha.
1946 — 51·900 ha.

These figures clearly illustrate the upward trend the cultivation of potato seed has taken in the Netherlands.

The great number of importing countries together with the quantities involved reflect the international appreciation of the outstanding characteristics of the varieties and the top-grade quality of the seed potatoes of the Netherlands.

Readers may be interested in a few details regarding the cultivation proper of Dutch setts and the way in which they are exported.

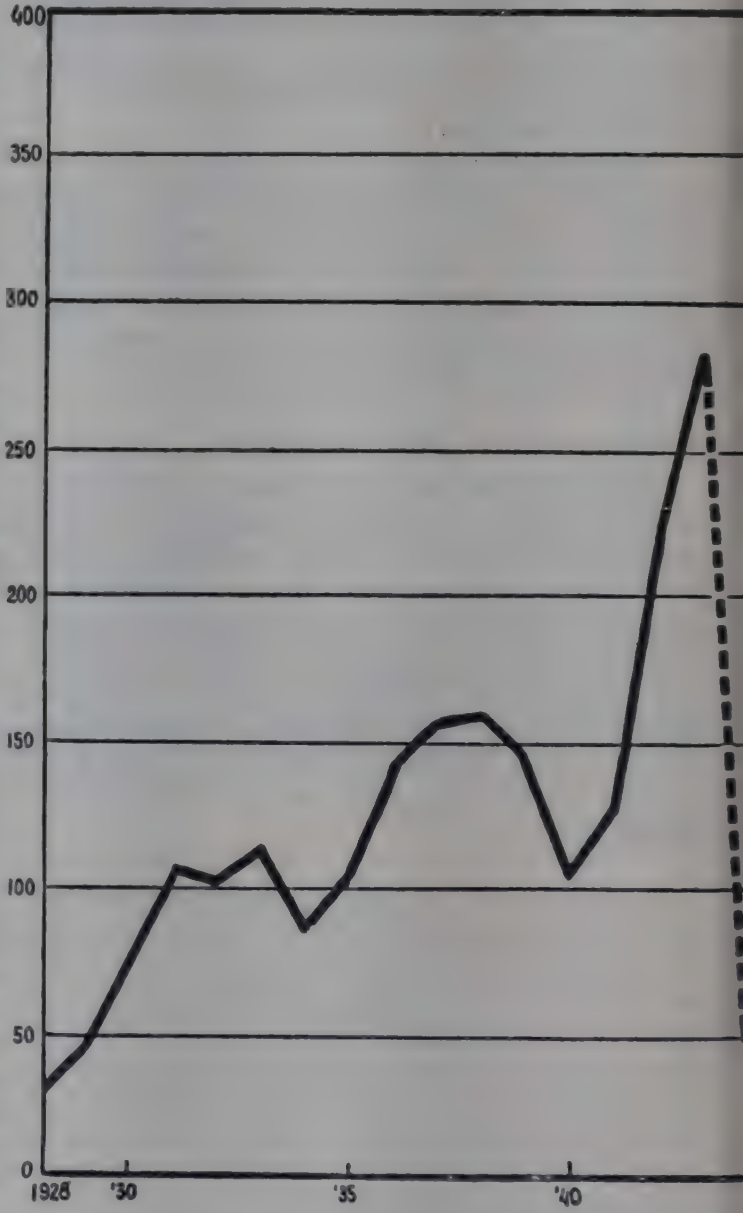

FIG. 1. Total exports of Dutch setts show an upward trend in spite of economic depression and World War II.

*Hectare is equivalent to 2·471 acres (10,000 sq. metres).

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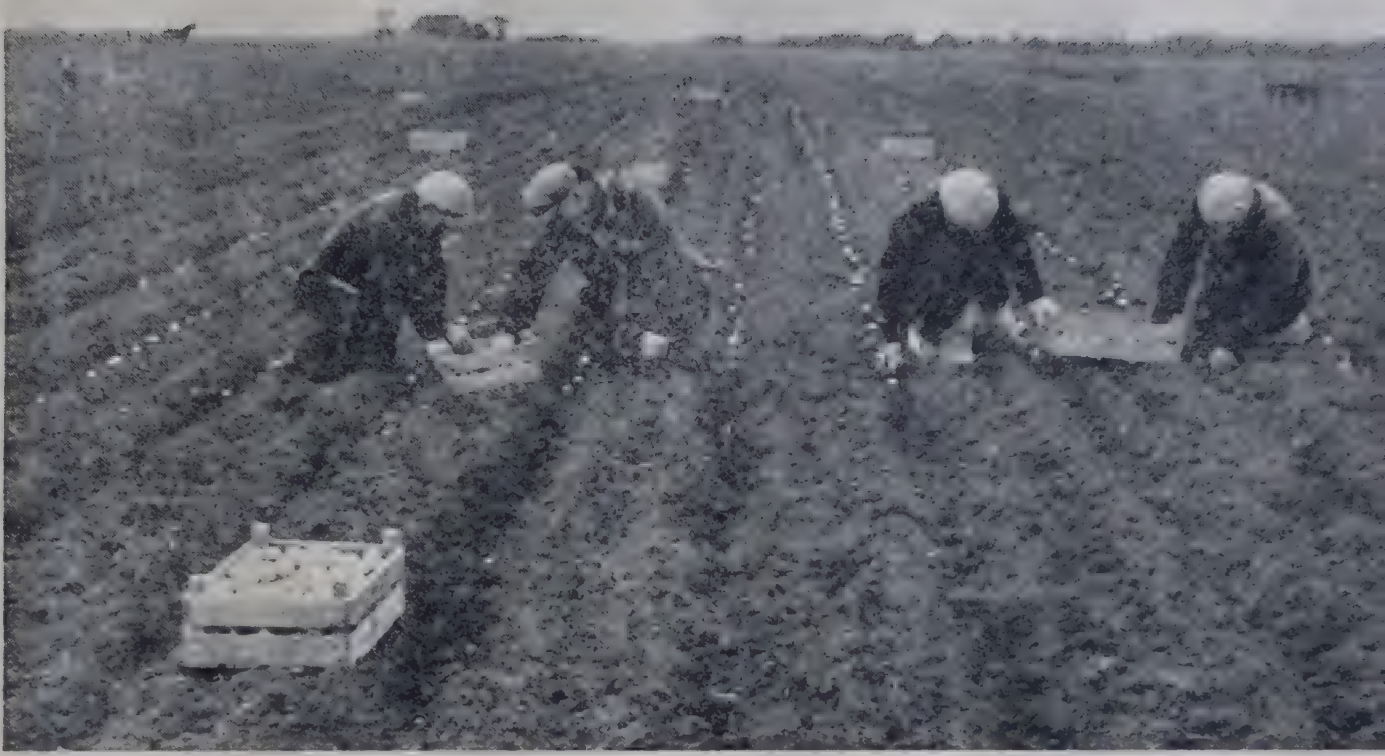


FIG. 2 (above). Hand planting seed tubers.

FIG. 3 (below). A large potato experimental farm is being inspected by some experts.

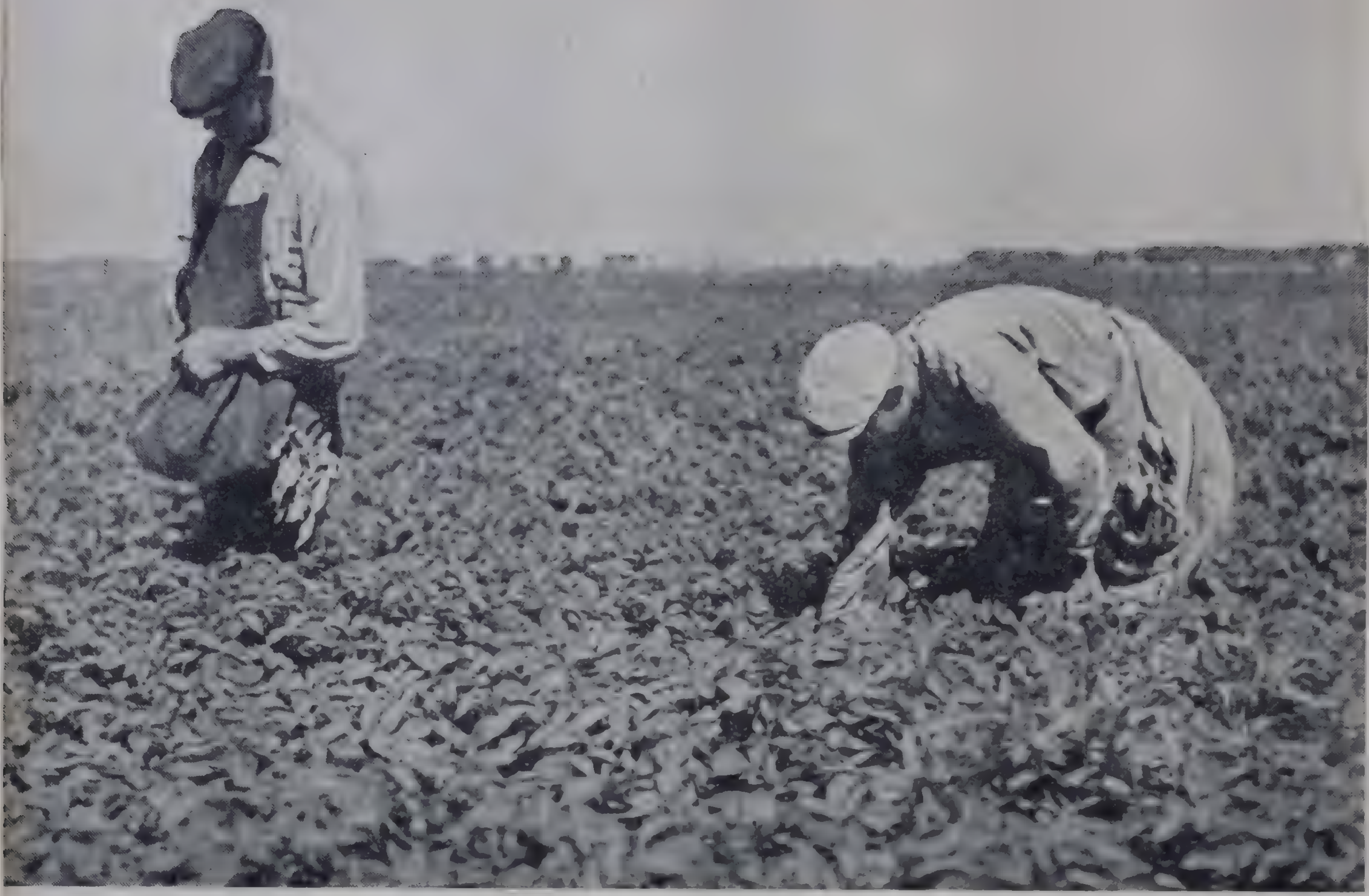
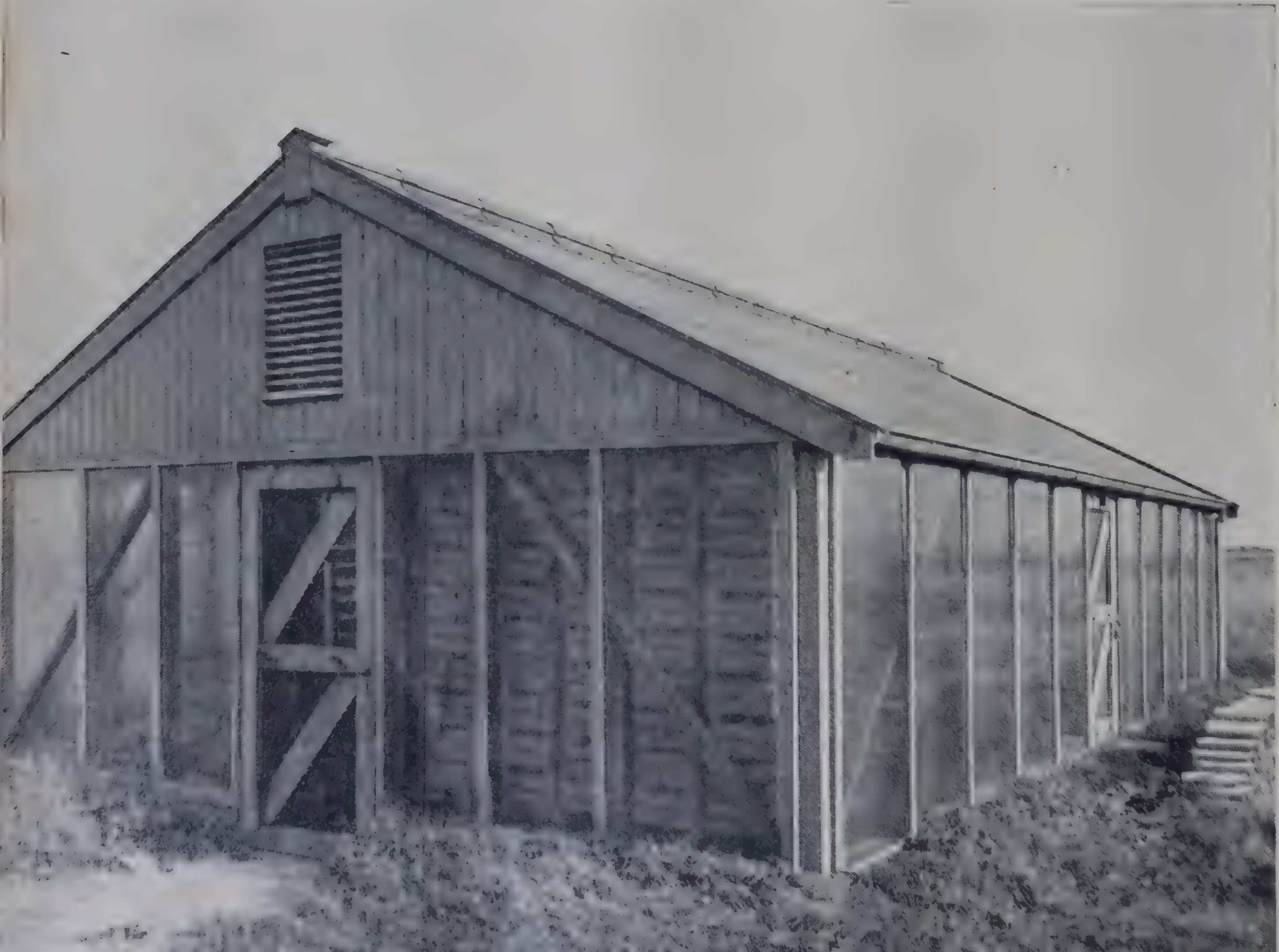


FIG. 4 (above). Selectors remove off-type and obviously diseased plants from the field and put them in the bag round their waist.

FIG. 5 (below). Exterior view of a storehouse for seed tubers.



Seed potato selection stations

Ever since 1900 seed potatoes have been grown in the Netherlands. In the early stages of the development of this industry the basic consideration was to meet the domestic demand. Later on, however, growers more and more applied themselves to the production of seed potatoes for export. After 50 years of development many growers to-day no longer apply themselves to the production of ware but exclusively to that of seed. Such enterprises are commonly referred to as 'seed potato selection stations'. The management of these holdings is fully adapted to this type of cultivation, while they have the disposal of special equipment, including glass-walled seed-potato storehouses and an expert staff for selecting the crop. The seed potato industry in the Netherlands rests, as it were, on three pillars: climate, expert handling and condition of the soil.

Now follows a brief survey of the methods applied in the Netherlands in seed potato growing.

Climate and soil

The Netherlands have a cool climate, which greatly favours the growth of the potato crop in general and particularly the cultivation of seed potatoes, because of the relatively small spreading of degenerating diseases.

Soil conditions in the Netherlands are particularly suited for the production of seed potatoes. Adequate drainage, efficient tillage and well-timed fertilization greatly further a rapid and regular development of the crop.

Storage and disease control

It is common practice at the selection stations to store the seed tubers which are to serve as foundation stock, in glass-walled storehouses. In these houses the tubers are kept in wooden boxes in which they are allowed to sprout. The planting proper is done very carefully, in order to avoid breaking off the sprouts.

A good theoretical knowledge of, and a wide experience with, the different potato diseases enable the Dutch seed potato grower to check to a considerable extent any disease that might affect the crop during the growing season. Sprays against Blight are applied several times during summer. Of equally great importance is the selection of the potato crop (i.e. the removal of diseased and 'off-type' plants and of such plants as are not true-to-type), special attention being paid to the seed-borne virus diseases. Selection activities start as early as possible, and are continued throughout the growing season. It is only in this way that healthy seed can be obtained.

Thanks to the favourable natural conditions and an up-to-date agricultural technique it is well within the bounds of possibility for Dutch growers to produce healthy, very productive setts.

Scientific research

Scientific researches into potato diseases have been carried on ever since 1916. Much pioneering was done in this field by Dutch research workers. In determining the virus which causes leaf curl and other defects in potatoes, and vectors such as aphids, and also in the development of control measures, the Netherlands played a leading part.

Various scientific institutions, whose activities are based on practical observations, are engaged in researches into potato diseases, thus largely contributing to the improvement of the quality of the seed potatoes. This is of all the more importance since a smoothly functioning agricultural advisory service, a well-organized agricultural education and active agricultural organizations see to it that the outcome of these researches is introduced into practical farming.

Consequently the cultivation of seed-potatoes in the Netherlands has a strong practical, scientific basis, which should be considered of primary importance.

Official quality control

The organization of quality-inspection in the Netherlands for seed-potatoes was taken up as early as 1903. To-day the quality is guaranteed by an official inspection-service, which is under Government control, the 'Nederlandse Algemene Keuringsdienst voor Landbouwzaden en Aardappelpootgoed' (General Netherlands Inspection Service for Agricultural Seeds and Seed-potatoes, by abbreviation of the Dutch name: N.A.K.) at Wageningen. The guarantees given, which bear on trueness-to-type, purity, health, and grading are based on an inspection of the crop and of the approved lots of the parcel.

Field inspection

By expert inspectors and graders of the N.A.K., the selected potato fields are inspected two or three times for trueness-to-type, purity, and health. On the basis of a strict control the plots inspected are either approved and classified as A, AB, B and C or they are condemned. When the approved crop has been lifted, it is prepared for delivery, which includes a grading of the crop in different standard sizes.

The grade is expressed in two figures, indicating in mm. the size of the square meshes of the riddle, over which the seed-potatoes are passed.

Bulk inspection

The seed prepared for delivery subsequently undergoes a bulk inspection performed by the officers of the N.A.K. At this inspection due note is taken of all internal and external defects and diseases of the tubers, while also the grading is inspected.

Certificate and seal

If the parcel comes up to the requirements, every sack or crate is provided with the certificate of the inspection-service concerned and closed with a seal, bearing the mark of the N.A.K. and the name of the inspection-service. The certificate bears the name of the inspection-service, the crop-year, the name of the variety, the grade, the size and the registration number of the grower.

Export control

Any parcel of seed-potatoes destined for exportation is inspected by the Phytopathological Service at Wageningen, to ensure that the parcel meets the import regulations set by the country concerned. With a view to this, every parcel is provided with a Certificate of Origin and one of Health.

Varieties suitable for exportation

In the 22nd Descriptive List of Varieties of Field Crops 1947 (obtainable free of charge on application from the Institute for Research into Varieties of Field Crops, 105 Hoogstraat, Wageningen, the chapter on Potatoes also in the French language), the varieties are mentioned which can be considered for export. Of every variety a detailed description is given of the properties of foliage and tubers, the yield, the susceptibility to disease, etc.

Besides the varieties that are already well-known abroad, including Bintje, Eersteling, Eigenheimer, Alpha, Furore, Voran and Industrie, special attention is paid to the as yet less known varieties Saskia, Doré, Wilpo and Record. With a few of those varieties the potato-grower abroad will obtain excellent results.

Although the Netherlands have already a great range of varieties at her disposal, it is continually endeavouring to produce new varieties generatively, which are more remunerative and of better quality, have better tuber properties and a higher resistance against various diseases and particular circumstances than the existing varieties. A great number of potato-growers is engaged in this difficult job. They avail themselves of the findings made by scientific research workers. By choosing the right parents, it is endeavoured to develop new varieties that are especially fit to meet the conditions in foreign countries.

In 1947 newly developed Dutch varieties were sent to various countries to be planted there on experimental plots, because the value of a certain variety for a country can ultimately only be determined in the country concerned.

Shipment

In conclusion it may be pointed out that the exportation of seed-potatoes is well looked after by a number of *bona fide* exporters. Long experience and the professional knowledge of the Dutch exporter are a guarantee for the keeping quality of the seed-potatoes during transport. Only potatoes which have been approved by the N.A.K. may be exported.

FIG. 6 (right). Interior view of a storehouse for seed tubers.

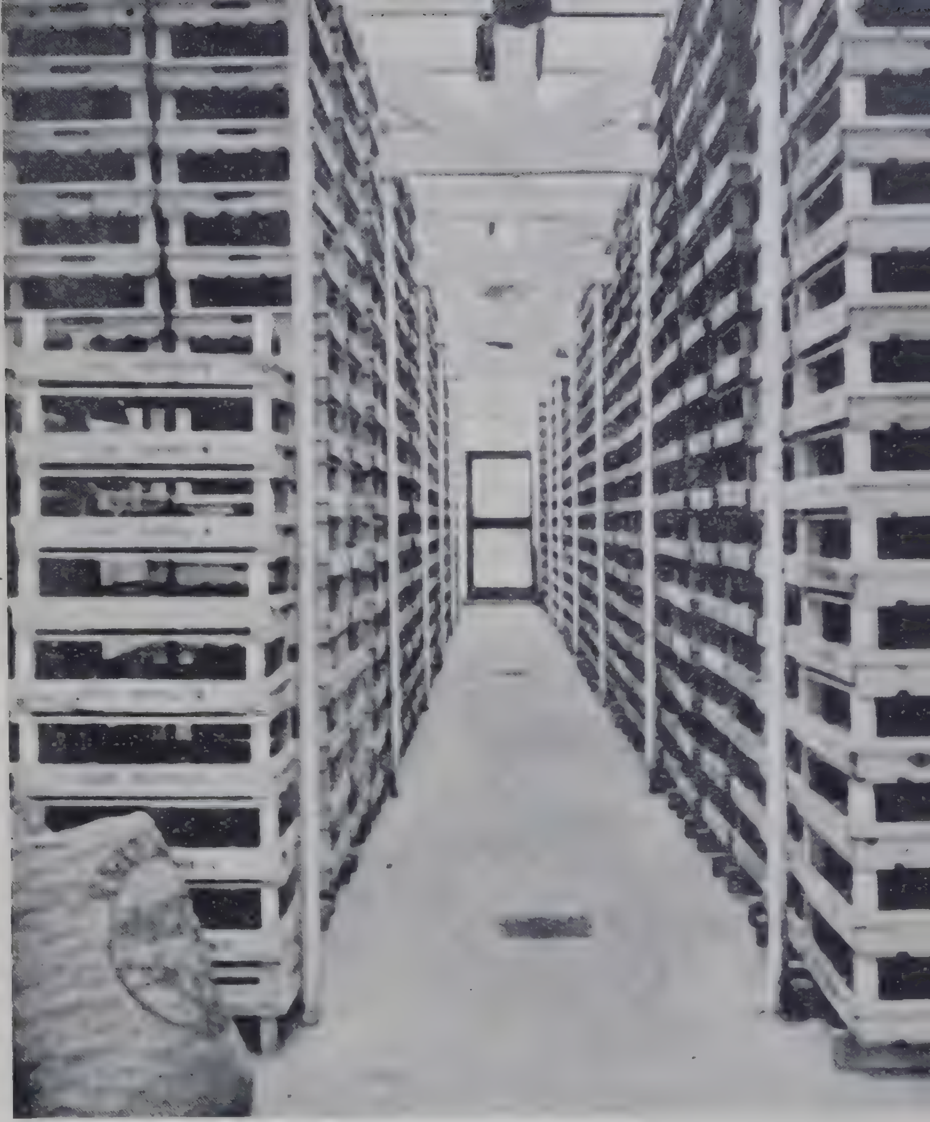


FIG. 7 (below). Loading crates into a sea-going ship.

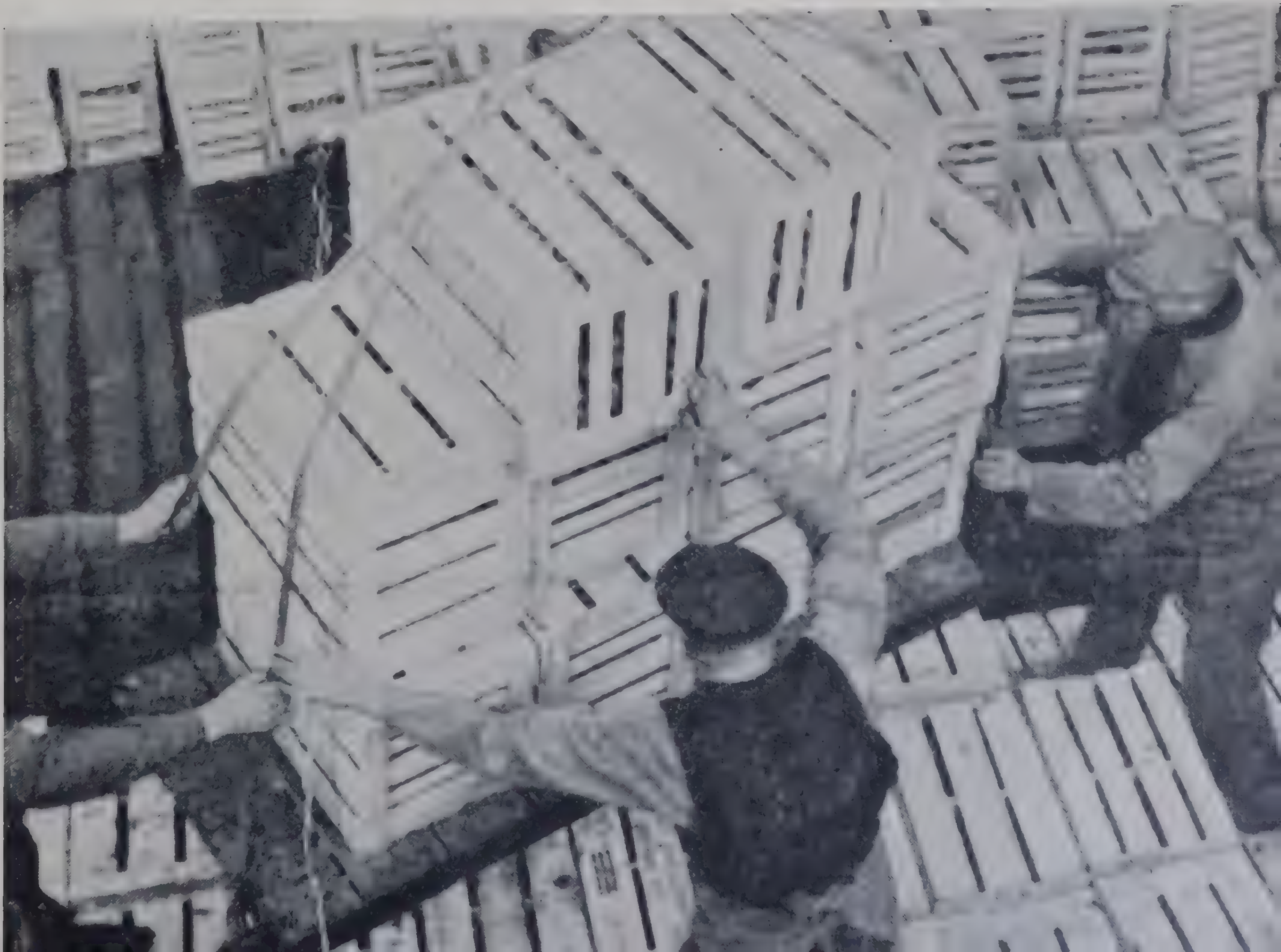
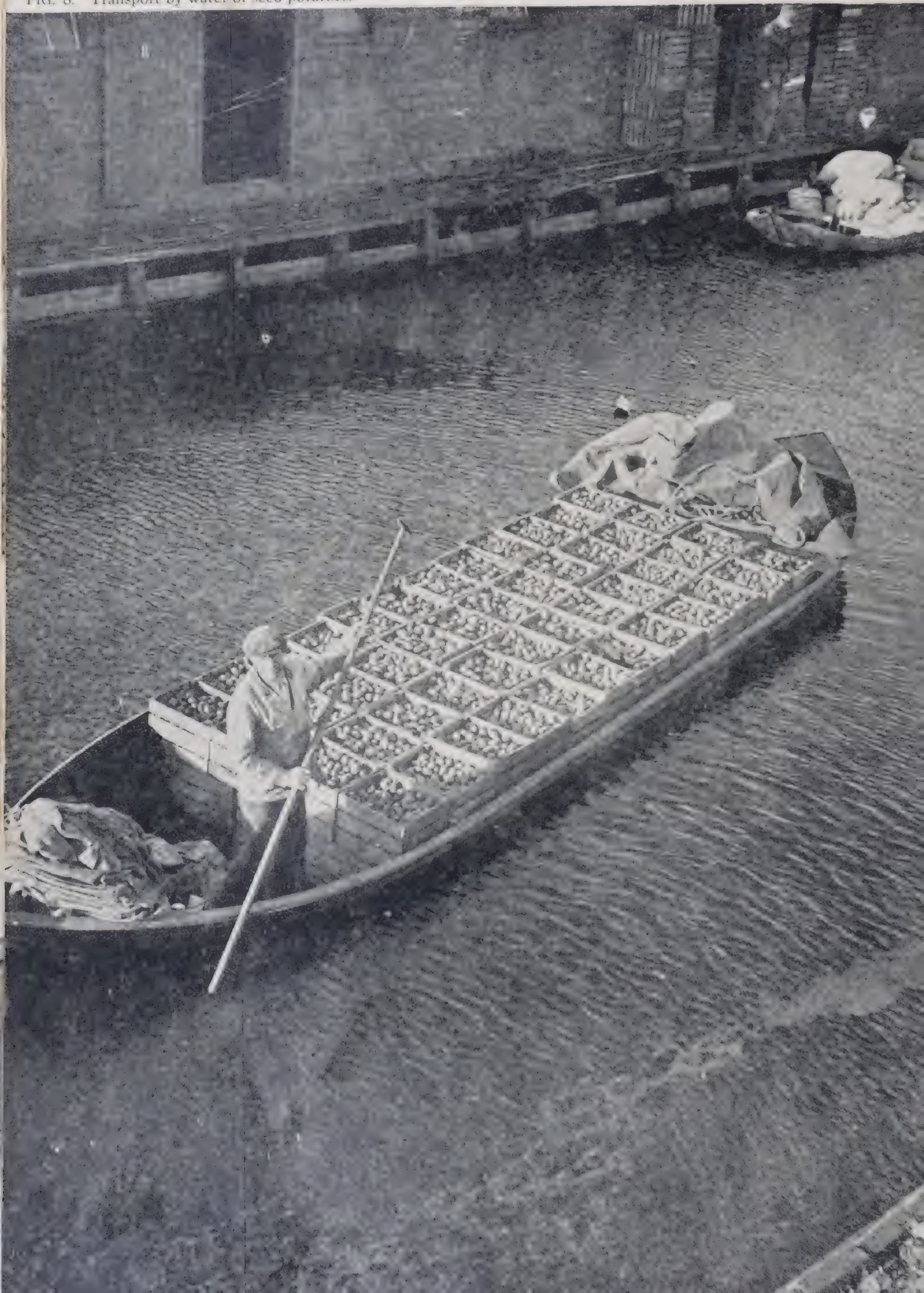


PLATE 9

FIG. 8. Transport by water of seed potatoes.



What the Scientists are doing

INCREASING FODDER PRODUCTION

IN view of the present food crisis in India, it is imperative and obligatory that our agricultural work has, as its objective, maximization of food production either by direct methods such as evolution and introduction of better varieties, better cultivation, application of manures, breaking up fallow lands, and the like, or by indirect methods, such as prevention of damage during storage, saving of seed, where possible, etc. thus adding to the stock of food grains available for human consumption. Not only is there food shortage in the country but, as shown by Chatterjee in the February, 1948 issue of *Indian Farming*, nutritional status of cattle in India is quite inadequate, the total production of roughages from cultivated crops and grass, etc. being enough to meet the requirements of only 78·52 per cent of the cattle population. If a method which would increase the production of fodder and improve utilization thereof by the cattle, without in any way lowering the yield of food grain, could be evolved it would decidedly be very helpful in reducing the existing shortage of fodder. Some work on these lines which is being done at the Institute of Plant Industry, Indore, is, therefore, briefly described below:

(1) It is well-known that thick and hard *juar* stalks (*kadbi*) are not fully utilized as fodder when fed to cattle. A seed rate and manurial trial is, therefore, being conducted with a view to finding out the effect of different seed rates on the yield and quality of *juar* stalks without adversely affecting the yield of grain. The seed rates employed are 10 lb. (thinned according to local practice) as control, and 5, 10, 15, 20 and 25 lb. (all unthinned) per acre. Each seed rate has one unmanured plot, and one manured plot, manured at the rate of 20 lb. N per acre as groundnut cake drilled before sowing in separate furrows. Results so far obtained show that seed rates ranging from 10 to 20 lb. per acre give significantly higher yield of grain (920 to 960 lb. per acre) than 5 and 25 lb. (675 and 569 lb. respectively), but manuring does not increase the yield of grain significantly. In the case of stalks (*kadbi*) it is seen that seed rates of 20 lb. and 10 lb. (unthinned) give significantly higher yields than the control, and manured plots give significantly higher yields than unmanured plots.

To find out the tenderness and palatibility of the stalks, the total quantity of stalks from each treatment was divided into two equal portions and then separately fed to the bullocks. It was seen that while 25 per cent of the stalks remained uneaten in the case of the control, only 13 per cent remained uneaten in the case of 10 to 20 lb. seed rates. These results thus indicate that higher seed rates up to 20 lb. give a higher yield of tender and palatable fodder (*kadbi*) without adversely affecting the yield of grain per acre and that a higher seed rate with manuring gives higher yield of palatable fodder per acre.

(2) Wheat seed rate experiments were carried out with a view to explore the possibility of reducing the seed rate usually adopted by the cultivators, which appears somewhat high, without affecting the yield adversely; such a reduction in seed rate, if possible, would result in saving of seed, causing thereby a corresponding increase in the stocks of wheat available for human consumption. These experiments were carried out under irrigated and unirrigated or *barani* conditions at the Institute and at various outside centres in the member-States of Central India and Rajputana. Results so far obtained have been in favour of a seed rate of 80 to 100 lb. per acre for irrigated wheat as against the local seed rate of 100 to 120 lb., and 60 lb. per acre for unirrigated wheat as against the seed rate of 80 lb. adopted locally.

In view of the fact that the acreage under wheat in the member-States of the Institute is of the order of about 18 lakhs, an average reduction of 20 lb. per acre in the seed rate, would thus result in augmenting the food resources of the States concerned to the extent of about 16,000 tons per year.

(3) Vast areas of the culturable waste land are infested with the pernicious weed *kans* (*Saccharum spontaneum*), the eradication of which is a very difficult task. Efforts are being made to break such lands with the help of tractor ploughs, to a limited extent. If eradication of *kans* could, however, be effectively carried out by the cultivators with the resources at their disposal, the work of bringing such lands under cultivation could be carried out on a country-wide scale. Various cultivation methods were, therefore, tried for this purpose, and the results obtained have conclusively shown that *bakharing* the *kans*-invested land, commencing from mid-October or beginning of November, at an interval of seven days for a period of eight months, is quite effective in suppressing the pernicious weed. In accordance with the prevailing rates of wages and cost of feeding of bullocks, the cost of eradication of *kans* by this method comes to Rs. 44 per acre. (D.V.B.)

PREFABRICATED GRAIN STORE

A BRITISH firm has developed a new type of prefabricated grain store. It employs the 'Venetian blind' principle which prevents condensation and maintains the flow of air. The square cells of the store are assembled from prefabricated concrete panels.

One important advantage of the invention is that ventilation is provided on all sides and at all levels. Another is that the square cells make for economy of space and can be easily erected, while more can be added to meet later requirements.

This type is claimed to be the answer to the problem of an inexpensive, easily operated and efficient grain storage system. (*London Press Service*).

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. May I know what measures are being taken in the country for the checking of wheat rust which causes considerable damage to the wheat crop ?

A. In July 1947 the Hon'ble Minister for Agriculture called a conference to consider the question of devising suitable measures to check the wheat rust. As a result of the deliberations of this conference it was decided that research on wheat rust should be intensified and that the problem should be studied on an all-India basis. With this end in view the Government have set up a high power Wheat Rust Control Committee charged with the task of coordinating research on wheat rust throughout the country. Schemes were accordingly invited from the Provincial and State Governments. Some of the schemes have been received and others are awaited. The Wheat Rust Control Committee held its first meeting in December 1947 to consider the general plan of work and the schemes received by it. The Committee decided that (i) the country should be divided into five zones :

Zone A. Bombay, adjoining States and Hyderabad.

Zone B. Central Provinces, Central India States, Indore and Gwalior.

Zone C. Delhi, East Punjab, Ajmer Merwara and adjoining States.

Zone D. United Provinces, Bihar, West Bengal and adjoining States.

Zone E. Madras, Mysore, Orissa and Travancore.

and (ii) that research should be conducted in each and every zone. It is expected that work in all the zones will commence at an early date. The Committee also decided that the control measures recommended by Dr K. C. Mehta, Principal, Agra College, Agra, should be tried for a period of three years. (I.C.A.R.)

SUGAR INDUSTRY IN INDIA*

I HOPE you will accept it when I say that I have been looking forward to meeting you all on this occasion. This desire is the natural outcome of the recognition of the plain fact that the industries dependent on sugarcane are of great importance and rank next only to those of our national industries which produce food and cloth for the people of this vast land. It has been estimated that about 20 million agriculturists and workers are dependent on the sugarcane industries among which I include the manufacture of *gur*, *khandsari* and sugar. Sugarcane also supplies to the nation a very vital element of human nutrition. It is obvious, therefore, that a gathering to which have come those who know the most about this important subject, cannot be missed by anybody who represents the Central Government of the country.

Inter-related problems

I have felt it my duty to reserve some time for attending your meeting in view of the inter-relation of the problems your Committee is expected to handle with our fundamental problem of food. Not only are sugar, *khandsari* and *gur* important items of diet of a large section of our people but one of these products of sugarcane is even of greater value as an article of food itself, its consumption in the country being three to four times the consumption of sugar. The extension of area under sugarcane may mean encroachment on the area under foodgrains. The prices of sugarcane can also have influence on the acreage ploughed for the cultivation of cereals. The yield of cane per acre has effect on its price and thus on the price of sugar and other products of cane. The problems of sugarcane are thus linked with the problems of food and cost of living which face the country to-day. I, therefore, thought that it was proper that I should attend your meeting and associate myself with matters which were thus so important.

Protective duty and self-sufficiency

I have been trying for some time to study the important work which your Committee has done during the last four years. It has been preceded by equally important work done by the Sugar Committee of the Indian Council of Agricultural Research. You have made great headway in more than one direction. I know that all those associated with the production of sugarcane or its products are desirous of even greater results. Some of you are well-known enthusiasts in the cause of research and its application in the interest of rapid advance in this, as in other vital parts of our national programme.

I am therefore anxious to share with you my hopes and fears with regard to this important industry of our country. It may be of value in helping us to shape our course of action if I take a little of your time to put plainly once again the main features of the situation though they are matters of common knowledge. Until 18 years ago the people of India were paying round about 16 crores of rupees to foreign countries for their sugar, this being the average of the value of foreign sugar imported into India for the preceding 12 years. Then came a big step taken by the Government to protect the Indian sugar industry against foreign competition. Towards this protective duty for our own national industry the people of India have paid out, it has been calculated, round about 70 crores of rupees. This sacrifice has placed the sugar industry on a firm foundation and we have come to feel that we can be self-sufficient in regard to sugarcane, *gur* and sugar. Our people have helped us to reach this safe position.

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* Speech delivered by the Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, at the meeting of the Indian Central Sugarcane Committee held on 9 October 1948.

Dangers ahead

But self-sufficiency in the above context is a relative term. The citizen of India needs more of nutrition that he is receiving to-day. Of both *gur* and sugar we are consuming in India only about 26 lb. per head per year. A citizen of Cuba consumes on average 88 lb. of sugar, of the United States 97 lb., of the United Kingdom 106 lb. and of Australia 160 lb. Based on a consumption of at least 2 oz. per day as part of a well-balanced diet a citizen of India would need about 46 lb. a year. This shows that the *gur* and sugar industry needs at least to double its product if the Indian citizen is to have his due in the matter of nutritious food. This opens up a wide scope for development. One hears sometimes of surplus stocks and glut in production of sugar in India. One hears of proposals for exporting of sugar from India. These may be temporary expedients to meet a situation which may have become out of joint for the moment. Consumption within India has an integral relationship with price. On the whole the history of sugar has shown that a lower price has meant greater consumption. I have no doubt that the interests of the nation demand that sugar in the form of *gur*, *khandsari* and refined sugar ought to be produced in twice the present quantity and be available to the people at a reasonably cheap price. The present high price of sugar is a danger signal. Our prices are double the world price. The first Tariff Board on sugar held the considered view that 15 years of protection to sugar industry in India would place it beyond fear of competition. To-day even after the lapse of that time we do not seem to have reached the stage when we could challenge open competition. The increasing urbanization of population and the adoption of modern habits of diet are going to be factors which would put cheap foreign sugar at a premium. Java is struggling to its feet with great rapidity and before much time has passed, its production is likely to reach the level of competitive exports to India. The situation needs bold and quick action. The State may help but the producers and manufacturers must also help themselves.

Even as it is, the danger of rising inflation which is leading to control of food and cloth would seem to call for reduction in the price of sugar pending any more fundamental measures for reducing the cost of production and so lowering the price of Indian sugar with a view to stimulate greater consumption and to meet foreign competition. It is a matter for consideration whether the price of sugarcane cannot be safely reduced to a lower level for the coming season so as to lower the cost of sugar. It is also a matter for consideration, whether there may not be a reasonable margin for a small reduction in price even of the present stocks of sugar. This would also be in line with Government's present policy. It would help to alleviate the hardship caused to the ordinary consumer and tend to increase consumption and consequently production. It may even help somewhat to maintain the export market. A high price of cane and sugar would also react unfavourably on the price of rice and wheat which it has been decided to control again.

Fixing sale price

India is at present artificially surplus in sugar. At the current prices, the consumption of the Indian Union cannot be more than 10 lakh tons of sugar, whereas our estimates of availabilities are 2 to 2½ lakh tons carry-over from the current year and 11 to 11½ lakh tons production in the next season. The best way of meeting the situation would be to increase our internal consumption. This can be achieved only by reducing the sugar price. It is a wise course for the sugar industry to adopt. Sixty to seventy per cent of the sugar price is accounted for by the price of sugarcane. It is, therefore, urgently necessary to reduce the cane price to a reasonable level in the coming season and to fix the price of sugar after allowing reasonable margin to the industry for manufacturing expenses and profit. The Government of India is now conferring with the Governments of the United Provinces and Bihar and will soon be discussing with the Sugar Syndicate in regard to these proposals for reducing the sugar price by stages so that the markets are not unduly disturbed and the industry does not suffer. The Government do not intend to re-introduce rationing of sugar. The price of sugar will be regulated, as this year, on the basis of an understanding with the Indian Sugar Syndicate which acts as the marketing organization for the United Provinces and Bihar factories. The Syndicate's functions would be to recommend selling prices for sugar and to allot quotas for sales to the different factories for the various consuming areas. It is to be hoped that the voluntary arrangements made by the Sugar Syndicate for distribution of sugar at prices agreed upon will prove to be satisfactory and no need will arise for any further intervention by the Government. It is also the Government's intention to constitute immediately a duly representative Sugar Advisory Council on the lines of a similar body which existed when sugar was statutorily controlled. The Council will consist of representatives of industry, growers and consumers.

Necessity for increasing yield of cane

The avoidance of the danger of foreign competition needs however more radical steps. The patient research work sponsored by the old Sugar Committee and the present Central Sugarcane Committee has led to valuable results. As I have just said, sugarcane accounts for 60 to 70 per cent of the cost of its products. The products cannot be cheapened to stand up against competition unless sugarcane is cheaper. Sugarcane cannot be cheaper unless we produce more of it. This need not be done by an increase in the area of cultivation. It would conflict with the extension of area under food or other crops which the country may need. The real remedy lies in increasing the yield of cane per acre. Your strenuous endeavours in the field of research have helped the country in the course of the last 16 years to increase the recovery of sugar from cane from 9·07 per cent to 10·31 per cent. The progress has been steady during the last 6 to 7 years, but it must be admitted that the progress has been slow. In this sphere of technical efficiency we are yet behind not only our principal competitor, Java, but also behind Formosa, Queensland, Hawaii, Natal, Mauritius and Cuba.

But as you all know there is a limit to the percentage of recovery of sugar from cane, nor is an increase in this percentage the real basis for reducing the cost of production. The wiser policy is to reduce the cost of the raw material which predominates so largely in the eventual cost of its products. This is possible primarily by an increase in the yield of sugarcane per acre. In our country during the last 16 years the yield of sugarcane per acre has been oscillating roughly between 14 to 15½ tons per acre. But this average includes the high figures of 30 to 50 tons per acre which different parts of the tropical region of our country can produce in contrast to the sub-tropical provinces of the United Provinces and Bihar. We realize how much leeway has yet to be made up in the basic operation on which depend the largeness of quantity and cheapness of cost of production of sugar and other products of cane. When we contrast this average yield of 15 tons of cane per acre in India with 30 tons in Egypt, 20 tons in Mauritius, 22 tons in South Africa, 27 tons in Philippines, 28 tons in Japan and Formosa, 41 tons in Peru, 56 tons in Java and 62 tons in Hawaii, we realize the extent of the ground we have to cover. I have no doubt that India can also produce enough sugar and sugarcane products for her full nutritional needs despite her growing population. There are parts of our country where a yield above even 100 tons per acre has been secured. We need not, therefore, increase further acreage under sugarcane. Our plans must largely converge on all those measures which lead to more intensive cultivation of the existing acreage. This is a solution not only in regard to sugarcane but also in regard to our foodgrains. With more intensive cultivation of the land and producing greater yield from the same area, our country can feed a much larger population than at present. This has been the experience of other countries and it has to be our experience also.

From the laboratory to the field

It seems to me that the warnings we are receiving of the need for more and cheaper sugar should compel us to put forth more intensive effort and to concentrate on first things first. The Central Sugarcane Committee should switch on its activities more and more from the laboratory to the field and set up some quick-moving machinery to bring to the farm of the cultivator the result of patient research conducted in the various centres. The application of our research in Coimbatore and acclimatization of the cane varieties which we cultured there, has enabled other countries to send back our Bangalore cane to us in the form of cheaper sugar and beat our own product in our own market. This has a lesson for us. We dare not take things easy. We cannot satisfy the people's needs or their opinion, if we move at our present pace. We must develop a sense of urgency and a sense of priority and, as I have just said, take up first things first. The agricultural side of the Committee's functions must, I feel, now definitely predominate. I have not the shadow of a doubt that our first and main task lies in the increase of yield of cane per acre both in the more favourably situated areas of Bombay, Deccan and South India as also in the United Provinces and Bihar. I would wish you to consider whether you may not set up a very small Development Committee which would tour the sugarcane areas at the appropriate time and by continuous contact at close quarters with the problems of increased production from the same area help the growers of sugarcane to reap due benefit from our research work. The war on the food front is no less a war than the one we fight with tanks and planes. The feverish activity which one associates with war measures should be the feature of every programme of production in the country to-day. I hope it will be possible for your Committee to take some effective steps which may, in the course of the next few years, speed up substantially the yield of cane from every acre now under the plough in our country. I see difficulties ahead for the grower and the manufacturer and also possibly the consumer unless our progress in this direction can be materially quickened.

Gur *and* khandsari *industry*

There is one other problem which in my view also needs urgent attention. It relates to the position of *khandsari* and *gur* industry in the rural economy of the country. It has been estimated that more than half the cane produced is used for the manufacture of *gur* and for every 6½ lb. of sugar consumed in the country 20 lb. of *gur* are used by our people as part of their food. I feel that it is desirable that a special Sub-Committee should be set up which should concentrate on the problems of *gur* industry as also the *khandsari* industry. Adequate finance should be placed at its disposal for the performance of its functions. The Central Sugarcane Committee had been charged with wide functions including specific agricultural, technological and economical research on *gur* as also other products of cane besides sugar. You may devise such measures as may be considered best for the fuller discharge of this particular function than has probably been possible so far. It is with a view to help in this matter that I have suggested an increase in the representation on your Committee of those connected with the *gur* and *khandsari* industry. I hope the suggestion will appeal to you. This is not the occasion for a comparative value of the various products of sugarcane from the purely nutritional point of view but as a very large number of our agriculturists and rural people are concerned in the development of these products of cane, it is imperative that we give to them the place which is their due in the programme of the Central Committee.

A suggestion for reorganization

May I venture, before I conclude, to submit for your consideration a suggestion for the reorganization of your work which, in my opinion, will be necessitated if you decide on a programme for achieving speedy results in regard to your major problems. I find that the General Body of your Committee has to consider both important matters of policies and comparatively minor specific schemes and proposals which relate to the details of your programme of work. I think two days discussion every six months only on the main problems, policies and programmes against the background of the changing situation in this country and the outside world, would be of great value in shaping the national line of action. The Government, the industry and the agriculturists concerned would benefit by the guidance which these discussions on the broader aspects of the question would give them. The exchange of views on the bigger and more fundamental issues by those who have given so many years of their life to the study of the problems relating to one of our vital food-producing industries would greatly contribute to sound conclusions being reached by the Government as well as by all others. It may be better if an Executive Committee of a dozen or so of your members is constituted which could deal with the comparatively minor items which also I find have been coming up before the General Body of the Central Committee. This Executive Committee could meet very frequently and could function also as the driving power pushing forward the progress of the detailed programme of action which may come to be formulated from time to time. I do not know how these suggestions would appeal to you. You may consider them and accept or modify them or unhesitatingly reject them if you think they would not suit the needs of the time.

I fully realize that no effective organization and no vital programme can make any progress without adequate funds. The President of your Committee has just referred to the cutting down of the annual grant by the Government from four annas to one anna per cwt. of white sugar produced in India. The Government's efforts for economy are to be guided by discrimination between schemes which relate to speedy progress in the production of essential commodities needed by the people and schemes which do not satisfy an important immediate need of the country. It will be my endeavour to help the Committee to secure adequate finances for its developmental activities and ensure a measure of financial stability on which foundation, the Committee may be able to build up a plan for national self-sufficiency in sugar and allied foodstuffs. As I have indicated already it will be a mistake to underestimate the place of this industry in relation to the national economy or the national diet of our people.

It is not my intention to deal with any particular items of your agenda. You will freely discuss each of them and come to whatever conclusion you think is wise and proper in the interest of not any one section but of the people as a whole. You are in a sense representatives of different interests, some of you are also representatives of different parts of the country with their own point of view. But it is my hope that in dealing with the major problems, I have ventured to place before you, you will feel as a single united body of patriotic Indians determined to help your people to secure adequate and cheap nutrition and to place India in a position speedily to hold its own even against heavy odds. I wish every success to your Committee's work and it is my pleasure to inaugurate its deliberations to-day. May I now request you to proceed to the discussion of the heavy agenda which is before you.

COORG

B. S. VARADARAJAN

IN Coorg as elsewhere people depend for their living mainly on agriculture. Everyone has sufficient land and grows his food and other garden crops like coffee, orange, cardamom and pepper. The major staple food crop is paddy covering an area of 86,000 acres. Normally in each holding all the crops are grown in some proportions, but there are regions where there are extensive areas of individual crops like paddy, coffee, orange and cardamom. Vegetable growing in every homestead is a common feature. Also plantains, arecanut and coconut trees are seen widely scattered in all the holdings.

The activities of the Agricultural Department have considerably increased, with the implementation of various schemes such as, 'grow more food' campaign, plant protection scheme and post-war reconstruction schemes. All the schemes are subsidized partly by the Centre and are planned with the expert advice of the Ministry of Agriculture and Indian Council of Agricultural Research. The progress made so far under each of these schemes is briefly given below.

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'Grow more food' campaign

In view of the wide scarcity conditions prevailing in the country, the 'grow more food' campaign initiated by the Agricultural Department has been intensified and great stress is now laid on maximum possible production of rice. By intensive propaganda the ryots have been persuaded to bring every bit of land under food crops. During the year 1947-48, under this campaign, reclamation of waste lands covering about 500 acres was undertaken. About 50 dams and tanks were either renovated or constructed. As a result of these works, there was an increased production of 500 tons. Arrangements have been made by the Department for the speedy procurement and distribution of manures on a subsidized basis. Thirty tons each of ammonium sulphate and ammonium phosphate were distributed. Due to the application of these artificials, there was an increased yield ranging from 5 to 25 per cent.

Compost scheme

In spite of the difficulties due to the continued dry season at the time of initiating this work, the staff employed conducted an extensive drive in all major villages of the province. Under the guidance and direction of the Department, 175 villages have taken up to compost-making in pits and 4,94,286 c. ft. of compost were prepared by the ryots for which a bonus of Rs. 10 per every 450 c.ft. of well-conserved manure was paid for accelerating the production of compost. The payment of bonus has given good inducement to the ryots and now they are showing signs of taking up the work of their own accord.

Though good deal of green vegetation abounds in this province, no practice of green manuring rice lands exists. To induce ryots to undertake green manuring in their rice fields, the Department is doing extensive propaganda and trials. Where green vegetation is not bountiful the Department distributes green manure seeds such as sunn hemp, and *daincha* to the ryots free of cost, advising them to multiply seed in their own respective holdings.

Improved strains of paddy have been procured from all important paddy-growing centres in the country. One note worthy is the superiority of local types of paddy over the exotic improved strains. The local varieties are commonly called 'Biliyas' and produce equal proportion of grain and straw. The grain is generally coarse but ranges from different shades of red to white. There are some heavy yielding fine varieties also among the local types in smaller areas. Among the introduced types of paddy G.E.B. 24, a strain evolved at Coimbatore, is found widely scattered. All the types are in the mixed state now and the question of improving the local types is under consideration.

Plant protection scheme

Systematic modern methods of controlling plant pests and diseases had not at any time been tried on a large scale in this province and hence both the pests and diseases have gained a strong foothold here. Since nearly one-third of the total area constitutes of an ever-green forest zone, there is a constant danger of pests and diseases appearing at regular intervals and attacking all cultivated crops. It has been estimated that the damage caused and losses sustained on account of ravages of these pests and diseases are over 25 per cent of the total production. Under this scheme, which was launched in April 1948, it is planned to protect all food crops and fruit crops against pests and diseases. Orange which is one of the cash crops of the ryots suffers a very heavy loss due to the outbreak of leaf and fruit-fall caused by *Phytophthora parasitica*. Spraying of orchards with Bordeaux mixture has been taken on hand and nearly 2,000 acres have been benefited by this spraying up till now. More areas can be covered up by spraying, but the limiting factor has been the procurement of proper spraying appliances.

Powdery mildew caused by *Oidium* sp. is brought under control by sulphur dusting and this has been introduced on a fieldscale.

Bordeaux paste is used in the case of 'Gummosis' caused by a species of *Phytophthora* which commonly occurs in many of the neglected orange gardens of the province.

The citrus stem-borer is a serious pest and injection of 3 to 4 drops of carbon di-sulphide against this appears to be a sure remedy and this has been introduced on a fieldscale.

Extensive preventive and control measures against the pests of paddy are on hand. An unidentified species of hairy caterpillar, which occurs commonly on higher elevation of terraced wetlands, causes heavy damage to the crop. The caterpillars in clusters voraciously feed and de-foliate the crop. The pest in its migratory phase cuts off the ear-heads and the loss in yield according to the estimation of the ryots ranges from 10 to 50 per cent. This obnoxious pest has been brought under control by taking recourse to the spraying of Guesarol (50 per cent DDT) 1 lb. in 30 gallons of water.

'Grow more vegetable' scheme

Under this scheme good quality seeds and manures were distributed free to those interested in vegetable growing. Also model nurseries were opened in Government Farms from where seedlings were distributed to intending growers.

French beans was the only vegetable grown in Coorg on a commercial basis. On account of the intensive propaganda carried out by the Department and owing to the facilities provided under this scheme other vegetables like radish, brinjal, chillies, cabbages, knol khol and cauliflower were grown on a large scale. So far both exotic and indigenous seeds were procured from the registered seed merchants. Three tons of ammonium phosphate and two tons of groundnut cake were distributed free of cost. The Departmental Staff, in addition to supply of seeds and manure, conducted advisory work on the methods of application of these manures, raising of nurseries, control of diseases of pests and the cultural requirements of these vegetables.

Apiculture

This province is a home of honey bees and normally there are two honey flows in a year when honey is collected and marketed. Honey and Wax Producers' Cooperative Association at Virajpet, South Coorg, which was established in 1936 has been procuring major portions of honey produced in the province and catering to the outside areas after doing standard processing operations. This Society handles on an average about 20,000 lb. of honey and wax. The Bee Instructor attached to the Agricultural Department does a good deal of advisory work among the ryots in handling improved appliances. Of late there is growing demand for establishing wooden box hives in places of old pot hives. The Honey Society caters to these needs by manufacturing them and selling them at concessional rates.

Recently a Central Apiary has been opened at Bhagamandla with one Apicultural Assistant in charge of it. The functions of this Station are (1) to evolve standard methods of apicultural practices to suit local conditions, (2) to standardise a type of hive capable of maximum output, (3) to supply to the bee-keepers young and prolific queens of desirable stocks, (4) to study the acclimatization of hill and plain bees, (5) to evolve preventive methods against natural enemies of bees and (6) to impart education to persons interested in the industry.

The various appliances needed are being procured and to start with different models of hives have been installed. The proper cultural side is yet to be developed. There are about 1,250 hives scattered all over the province. The two honey flows are confined to December to February and May to July. During the latter period, major flow of honey is generally recorded. The maximum number of colonies that a single bee-keeper owns is thirty and the minimum is one. Those who keep wooden hives also keep colonies in pots, hollowed logs of wood and kerosene tins.

Eradication of rinderpest

During 1941-44 rinderpest occurred as an epidemic and took its full toll due to which many ryots suffered heavy losses. During the month of December 1944 an attempt was made to provide all bovine population with goat tissue vaccine on a mass scale. Wherever the epidemic was virulent, Veterinary Assistant Surgeons were provided with stockmen to assist in the work. To prevent epidemic getting into the province from the bordering villages of Mysore, masscale inoculation was undertaken in the bordering villages. In addition, all the cattle that were exported to this province were subjected to quarantine measures for a period of one week at the frontiers and released for sale thereafter. This is still being continued. By these means the disease was brought under control by the middle of 1945.

According to the instructions of the Government of India, a scheme for a period of two years for the reduction of cattle mortality by the epidemic by known biological products was prepared and this was put into operation in June 1946. Out of 1,39,880 heads of cattle population in Coorg, 1,26,000 heads have been protected up till now and the operation is still in progress.

Method of operation : Under this scheme a veterinary mobile corp consisting of a Veterinary Assistant Surgeon and eight stockmen were established. The Veterinary Assistant Surgeon directed and supervised the work of the stockmen. The mobile corp commenced the work in the western border of the province as the belts on the other three sides of the province had already been formed. When the western border was completed the mobile corp was disbanded and the stockmen were posted under the different Assistant Surgeons for the mass protection of the cattle in the interior villages.

The epidemic is now under complete control and not a single outbreak is seen ever since the scheme was launched.

Reactions : The reactions of the vaccine on the whole were very mild. There was not a single case of mortality. The people of the area suffered to some extent for want of milk. On the western border, though the reaction was mild, some animals became very weak and a few of them succumbed after three or four months. This was mainly due to scarcity of fodder. At the commencement of the scheme there was certain amount of opposition against vaccination, but after realizing the inestimable value of vaccination, the farmers themselves desired revaccination.

HYDERABAD-DECCAN

M. R. KAMKOLKAR

THE Hyderabad Government has created a Publicity Section in the Department of Agriculture. The aims and objects of this scheme are the following :

(1) Running of Hyderabad Farming Association.

(2) Publication of *Hyderabad Farmer*.

(3) Organizing agricultural shows, exhibitions and demonstrations in public fares.

(4) Coordinating the work of the different associations of the farmers.

(5) Dissemination of the results of research and experimentation.

(6) Publication and distribution of leaflets, circulars, pamphlets, etc. written in popular languages of the State.

(7) Arrangements for the writing and publication of books and articles concerning the various branches of agriculture and translation of similar books into Indian languages.

(8) Training the agricultural staff in the methods of publicity and propaganda.

(9) Preparation of pictures, photos, posters and charts for demonstrations.

Agricultural Research Laboratory

In view of the expanding research work in connection with the improvement of castor seed and the consequent need for a suitable well-equipped laboratory, H.E.H. the Nizam's Government have, at the instance of the Agricultural Department, sanctioned a scheme for the construction of a new laboratory at the Main Agricultural Experiment Station, Himayat Sagar, at an estimated cost of Rs. 81,700.

Scheme for composting town-wastes

The average crop yields of the State of Hyderabad are generally very low as compared to the yields of agriculturally advanced provinces. This is mostly due to the low fertility of the soil. As a good deal of wastes are available in the State for conversion into rich manures, the Compost Scheme was taken up by the Department of Agriculture as a part of the 'grow more food' campaign. During the first two years, the scheme was financed entirely by the then Imperial Council of Agricultural Research and later on by H.E.H. the Nizam's Government.

The objects of the Scheme are (i) to conserve urban habitation wastes such as street sweepings, night-soil, slaughter-house refuse, sewage and sullage, (ii) to process them scientifically into rich synthetic manures at convenient municipal centres, and (iii) to make the manure available to farmers at an economic price.

Trenches of varying or convenient sizes are dug at the outskirts of the town. Each trench is not more than 3 feet deep. Standard trenches are 25 ft. × 6 ft. × 3 ft. A layer of town sweeping about 6 in. thick is spread at the bottom of the trench. Over this is spread a layer of night-soil 2 in. thick. Succeeding layers of sweepings and night-soil are added alternately till the heap rises to a foot above the ground. The top layer of sweeping should be about 9 in. thick. After a few days, the material sinks. Further layers should be added till the heap is one foot above the ground. A

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similar process is adopted to compost town-refuse with slaughter-house refuse, adding sewage or sullage water. The compost would be ready in four to six months, and free from odours. It is superior to farmyard manure and contains, on a dry basis, 1 per cent nitrogen and 0·7 per cent phosphoric acid. Its potash content is considerably high, being 1·5 per cent to 2·0 per cent, which makes it specially suitable for the potato and vegetable crops.

Farmyard manure prepared by farmers is sold at about Rs. 2 to Rs. 3-8 per cart-load, whereas the compost is available at twelve annas only. At the present level of manurial ingredients, a cart-load of compost is worth about Rs. 10.

The Biochemist of the Department of Agriculture at first set himself to train a nucleus staff of 4 Assistants. Later on, 5 Maistries and 35 Sanitary Inspectors were trained in compost-making from town wastes.

Starting with nine municipal centres in the first year, the work was extended to 33 centres in the second year. The number of centres now on the list is 35, but of these only 20 are actively functioning, producing annually about 10,000 tons of compost sufficient for about 2,000 acres.

The State of Hyderabad has an urban population of 2,194,294 in 138 towns and cities, and a rural population of 14,144,240 in 22,360 villages. Calculating at a basic rate of 10 per cent in the case of urban population and 2·5 per cent in the case of rural population, the State may be expected to produce 570,000 tons of compost, enough to manure 114,000 acres of land at the rate of 5 tons per acre. Similarly, by converting the farm wastes into compost, another 5,000,000 tons of compost may be expected, sufficient to manure 1,000,000 more acres of land. The expected extra food grains due to 4 per cent of the bulk of the manures would be 5,360 tons from habitation wastes and 40,000 tons from farm wastes.

Progress is however feasible if adequate trained personnel, transport facilities, and equipment are available.

Improved Nanded cotton

Bani or Gaorani cotton of Hyderabad was grown on about ten lakhs of acres. It was famous for its fine quality lint and high spinning. The well-known Dacca muslins were manufactured from this cotton. In course of time, however, the quality deteriorated and the yield decreased. Improvement work was started in 1929 by the Department of Agriculture, and a selection was obtained known as Gaorani 6. It has a silky feel, gives a higs yield, has a staple length of 0·85 inches, gins 31 per cent and spins 36 counts. Owing to these superior qualities, Gaorani 6 is liked by the trade and fetches a high price to the cultivators. The strain soon spread among the cultivators. The Department of Agriculture spared no pains in popularizing it. Now the entire area in Nanded grows that variety alone, and the cultivators annually get 25 to 28 lakhs of rupees more than what they would have got with their old Bani cotton. The strain, however, would deteriorate if its purity is not maintained by constant vigilance. The Department of Agriculture has taken upon itself the supervising of about 40,000 acres of the crop in Nanded District sown with pedigree seed to maintain its purity. This area is called the 'Reserved Area'. The produce from this area, which is about 6,000 bales of lint cotton, is particularly sought by the trade who pay for it a premium of 3 to 10 per cent over the price of the same type of cotton grown generally by cultivators in other areas. Thus, the maintenance of the purity of strain alone fetches to the cultivators another extra income of about a lakh of rupees.

The Reserved Area mentioned above is made up of five blocks each of which is situated round about the following cotton markets: (i) Nanded, (ii) Umri, (iii) Karkheli, (iv) Dharmabad, and (v) Bhainsa.

Each block is expected to supply 1,000 to 1,500 bales.

Auction for the fixation of premium for the produce of the above Reserved Area was held this year, after due notification in newspapers, in the Nanded Club Building, on November 17, 1948 under the presidentship of Mr. C. L. Gupta, the District Civil Administrator, and in the presence of Rai Mohindra Bahadur, Director of Agriculture, and other officers. The auction was attended by a large body of merchants from several parts of India. The following were the results of the auction:

S. No.	Block	Highest bidder	Percentage of premium over prevailing market rate	Remarks
1	Nanded	Messrs. Gazdar and Co., Bombay	Rs. 3– 8–0 Rs. 3– 0–0	For G. 6E-3 For Gaorani 6
2	Umri	Tata's Empress Mills, Nagpur	Rs. 3– 0–0	For Grorani 6
3	Karkheli	Osmanshahi Mills, Nanded	Rs. 5–12–0	,, ,, ,,
4	Dharmabad	Messrs. Gazdar and Co., Bombay	Rs. 5– 8–0	,, ,, ,,
5	Bhainsa	Tata's Swadeshi Mills, Bhainsa	Rs. 3– 0–0	,, ,, ,,

NEW FARM COMPOST

IN Australia, a municipal council is turning garbage into an organic manuring material, similar to compost.

Garbage rich in discarded food is preferred. After picking over for tins, metal and glass, the garbage passes by conveyor belt to a hopper. Here bacterial seed, in earth, and a small amount of lime, are added and the mixture conveyed to the bacterial digester. In this 50-ton container, the matter is slowly stirred and mixed together for two days. The bacteria, it is claimed, converts the garbage into good manure, which Government analysts say will eventually turn into compost.

From 100 tons of garbage about 50 tons of marketable product is obtained. This sells at £A5-15 a ton bagged or £A3-15 in bulk.

A quantity of the manuring material has already been sold to the Murrumbidgee Irrigation Area in New South Wales, and 500 tons are on order for banana growing at Coffs Harbour, northern New South Wales.—*Australian Agricultural Newsletter*, No. AGN/229.

Across the Borders

MODERN TRENDS IN WEED CONTROL

By H. E. ORCHARD

RESEARCH workers who have been charged with the task of supplying the means of controlling weeds are beginning to realize that, irrespective of the means of control to be adopted, be it a cultural, chemical, competitive cropping, mechanical or biological method, such control should be coupled with sound land use and should only be undertaken with due attention to:

(1) Best time of the year for control.

(2) Cultural practices likely to maintain the controlled condition.

(3) Use of crops or fodder plants likely to prevent any further growth of noxious plants.

(4) Adequate control on neighbouring lands.

Many noxious plants are most profitably controlled by proper cultural methods. In some cases all that is required is an alteration in the cropping rotation to include the seeding down of either short term smothering crops or semi-permanent competitive fodder plants. In other instances, as has been found in the case of Cape Tulip control, correctly timed tillage operations are necessary, combined with a variation in cropping practice to include, where possible, summer fodder crops.

Pavlychenko, following his recent Canadian experiments, states that ‘ it is a sound principle of weed control to take advantage of the relative competitive efficiency of weeds and crop plants ’, and recommends ‘ whenever it is possible to control a weed by making it compete with a crop which is more aggressive than the weed and highly adapted to the habitat where the weed is found, such a method of control or eradication is usually not only the soundest procedure but the most economical as well’.

Where their growth and seeding habits cannot be controlled by farm operations or changes in land use, noxious plants may constitute a real menace, and if their continued presence is the cause of diminished returns from the land, special control may be advised, such as chemical or mechanical means of extermination.

These special control measures must always be regarded as methods only to be resorted to after proper farm operations or changes in land use have proved inadequate.

It is because many of our most troublesome weeds are not controlled by these more economic methods that the most recent advances in noxious plant eradication have been concerned with the development and application of special controls.

The most revolutionary of these is the use of plant growth regulating substances, commonly known as Methoxone and 2, 4-D, as weedicides. Among others becoming more widely recognized are the selective control of weeds in lucerne with oil and dinitro products, the selective control of weeds in carrots with stove oil and kerosene, pre-emergence sprays for general weed control, the use of fortifying agents for contact sprays and the improvement in application equipment.

However, good farm management practices will not be supplanted, as the need for them is as great as ever.

Plant growth-regulating substances

The majority of field work against weeds growing in cereal crops has been done in England with Methoxone and Agroxone and in America with 2, 4-D. Members of the grass family are much more resistant to these substances than broader-leaved plants as a class, making possible their use as selective weed-killers.

Generally speaking, control results were extremely satisfactory and all available reports indicate that crop yields, following applications of these materials, were materially increased. Small cereal grain crops should be sprayed when four to six inches high for control of such weeds as wild turnip, mustard, and thistles. The method of application of these chemicals is of first importance for such field use, and much interest has been shown in a turbine type of machine using an air blast into which is fed as little as five gallons of a solution of 2, 4-D (to cover one acre). An even more recent development is the Canadian low volume spraying boom which is capable of developing as little as 1½ gallon of weed-killer per acre.

Other uses of hormone-type weedicides

The plant growth-regulating substances, often referred to as hormone-type weedicides, have also been used successfully for the eradication of competing weed growth in the rice crops, fruit tree plantations, vineyards, lawns and grass-seed crops.

Selective control of weeds with dinitro products

Outstanding results have been achieved both in Australia and overseas with the use of dinitro products, 'Dinoc' being the major one employed here, against weeds, particularly in flax and onion crops, while during 1946 farmers in California treated 75,000 acres of cereal grain crops with dinitro weedicides for the suppression of crop weeds.

Control of lucerne weeds with chemicals

Experiments being conducted in America herald a revolutionary method of keeping lucerne fields free of weeds. These experiments have indicated that weeds of broad-leaf type could be controlled in seedling lucerne stands and that broad-leaved weeds and grassy weeds could also be controlled in established lucerne. When the proper dosage of the ammonium salt of dinitro secondary-butyl phenol, a selective herbicide, is applied at the correct time such weeds as mustard, wireweed, shepherd's purse, fat hen, chick weed, and docks are effectively controlled in seedling lucerne fields, while for all practical purposes the young lucerne plants are unaffected by the chemical applied. Weeds in established lucerne were controlled by contact weed-killers which kill the plant tissue of the weeds with which they come in contact. Application was made during the winter when the lucerne was dormant and little affected, as it is perennial with food reserves and protected crown buds. Either Diesel oil, or oil-water emulsion, or a dinitro product in an oil-water emulsion was used to control chick weed mustard, shepherd's purse, foxtail, annual blue grass, perennial ryegrass seedlings and young established ryegrass.

Pre-emergence weed control with oil

The use of oil sprays to control the first infestation of weeds before the seeded crop has emerged has been termed pre-emergence weed control and is a comparatively new departure. While success has been achieved employing this method, a means of standardising oil for this phase of weed control is needed, as the great variations in oils lead to undesirable results.

Oil weed control in orchards and vineyards

The annual use of oil sprays for weed seedling eradication in citrus groves and vineyards has in many instances in California, where the method has been most thoroughly tested, made cultivation unnecessary. The progressive reduction of weed seed in the top soil by the alternate processes of germination and the subsequent destruction of seedlings with oil sprays has resulted in a minimum operation; the upper root zones of the trees are not disturbed and the trees and vines are maintained in a healthier condition.

Electric weed control

For the past several years an overseas authority has been investigating the electrical control of Russian Knapweed and Hoary Cress on an operational basis but with variable results. Reports indicate that more field work is required before the possibilities and limitations of eradicating weeds by this method are understood.

Flame cultivation, weed-burners, and flame-throwers

With the advent of the 'Sizz-weeder', a multi-weed burner machine which has rendered possible the total mechanization of the production of cotton, much interest has been aroused in the use of both burning chemicals and heat as methods for weed control.

Searing of plants with weed-burners (which are in reality very similar to the painter's blow-lamp, though larger) supposedly sets free certain toxins which are translocated in the plant and bring about its death. The nature of such toxins set free and how they are translocated within the plant have not yet been discovered, although practical applications of this searing principal are already in commercial use.

The flame-thrower is essentially different from a weed-burner in that it works on the principle of kindling and maintaining a fierce fire in a plant, bringing about its destruction by burning.—Reproduced from the *Journal of the Department of Agriculture of South Australia*, June 1948.

Home Gleanings

COCONUT *POONAC* AS A FOOD FOR LIVESTOCK

TO breeders of livestock in Ceylon coconut *poonac* is of special interest because it is produced locally and in large quantities. At a time such as the present when supplies of imported foodstuffs are precarious, it becomes of even greater interest and importance. With shortage of supplies and rising prices of other foodstuffs coconut *poonac* will of necessity have to enter even more largely than in normal times into the rations fed to livestock. It is of value at such a time to consider how best this foodstuff can be utilized for various classes of stock.

Chekku poonac

It is hardly necessary to state that there are two important types of coconut *poonac* available in Ceylon, namely, *chekku poonac* produced by crushing copra in the local type of press or *chekku* operated by bulls and mill *poonac* produced by crushing copra by various types of machinery in modern mills.

Analyses of both types are given below. It will be seen that the most important difference between the two types is that *chekku poonac* contains a very much higher percentage of oil than mill *poonac*. Indeed the proportion of oil is so high that it makes *chekku poonac* definitely unsuitable for feeding in any considerable amount to some classes of livestock.

This type of *poonac* is produced in small quantities as compared with mill *poonac* and finds its greatest use as a food for cart-bulls engaged in heavy work. If used for dairy cattle the amount fed per day should be limited as large quantities are likely to depress the milk yield and lead to an overfat condition of the cows. It may be used more liberally for young growing cattle but any tendency of the cattle to become overfat, especially in the case of heifers, should be checked as soon as noticed by reducing the quantity. As a food for pigs, *chekku poonac* is definitely unsuitable for the production of the best quality pork, as the carcass of pigs fed largely on it will be excessively fat. It is also unsuitable as a food for hens for the same reason.

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With these few remarks about *chekku poonac* we will pass on to mill *poonac* which is available in much larger quantities and is more generally used.

Mill poonac

Coconut *poonac* differs from other *poonacs* such as gingelly, earth nut, linseed, etc. as it is much softer and absorbs water very readily. On account of this its keeping qualities are not so good as of other harder *poonacs*. Unless stored in a very dry atmosphere it is apt to become rancid and mouldy rather rapidly.

For this reason it is not wise to lay in large stocks unless a good dry store-room is available.

When soaked in water it swells very considerably. If fed dry in large quantities there is danger of the stomach becoming over-distended. To avoid this it is the usual practice to soak it well before feeding.

Coconut *poonac* has a very distinct taste and smell of its own. Livestock which have not been accustomed to it often refuse to eat it at first, but they soon become used to it and eat it readily.

Chemical composition

The composition of an average good sample is given in the Table below.

TABLE I

Analysis of mill and chekku poonac

	Mill *poonac* per cent	*Chekku poonac* per cent
Water	11·4	12·4
Oil	8·0	15·0
Protein	21·2	18·0
Carbohydrate ...	42·4	41·0
Fibre	11·5	5·6
Ash	5·5	8·0

This shows that coconut *poonac* falls into the class of foodstuffs moderately rich in protein such as palm-nut cake or undecorticated cotton cake. It contains considerably less protein and more carbohydrate than such foods as gingelly, earth nut or linseed *poonacs*. The oil content is roughly the same as in linseed cake. The total mineral content is round about the same as in most other oil-cakes or *poonacs*. A feature of the mineral content which requires to be borne in mind is that it is very poor in calcium. Coconut *poonac* is a good source of supply of phosphorus but a poor source of calcium.

The oil contained in this *poonac* is a 'hard' oil. Butter made from the milk of cows fed on it will be firm in consistency as will the fat of pigs which have been fed largely on coconut *poonac*. This is a valuable property especially in a warm climate.

An interesting fact about the composition of coconut *poonac* is that its nutritive ratio, that is, the proportion of protein to carbohydrate and fat, is 1 to 4. This one to four ratio is the generally accepted correct ratio for a balanced ration for milk production in cattle, for young growing pigs, and for egg production in poultry. In other words coconut *poonac* is in itself a balanced ration and can be added to any balanced mixture of foodstuffs without altering the nutritive ratio. Any livestock owner who is using a mixture of foodstuffs which has been compounded so as to form a balanced ration can add coconut *poonac* to the mixture in any quantity required without the necessity of working out rather complicated calculations.

The points to be observed when feeding coconut *poonac* to various classes of livestock are summarized below:

For cattle: It has been stated above that coconut *poonac* is in itself a balanced ration for milk production. That means that it contains protein in the correct proportion to carbohydrate and fat. It is not, however, safe to assume that coconut *poonac* alone as the concentrate ration will be ideal for dairy cattle. For instance such a ration would certainly contain too little calcium to supply the needs of a milking cow.

There are many cows in Ceylon which receive little else than coconut *poonac* as a concentrate ration. Such cows may milk well and look well as a rule, but it is not uncommon to hear their owners complain that they experience difficulty in getting such cows to calve regularly. The cause of this difficulty is most likely the deficiency of calcium and possibly in addition an overfat condition of the cows as a result of depending too much on coconut *poonac* alone. The deficiency in calcium can be corrected by adding a simple mineral mixture such as two parts of ground limestone or coral and one part of common salt to the *poonac* and it is strongly recommended that in all cases where coconut *poonac* forms a large part of the ration such a mineral mixture should be used. Three pounds of the mixture of limestone and salt should be added to each 100 lb. of *poonac*.

The deficiency of calcium in coconut *poonac* can also be corrected by including in the diet some foodstuff which is rich in calcium. Prominent among foods which can be added to coconut *poonac* for this purpose are gingely *poonac*, any of the pulses such as *dhal* husk and gram.

This method of correcting the deficiency of coconut *poonac* is better than the addition of a mineral mixture because the calcium as contained in such foods as gingelly is more readily assimilated by the cattle than when it is in the mineral or inorganic form. The obvious drawback, of course, is the higher price of gingelly *poonac* as compared with the cost of a mineral mixture.

For feeding of pigs: Coconut *poonac* is very largely used as a pig food in Ceylon. Pigs are often reared on a diet which consists largely of coconut *poonac* and water grass.

Such a diet may give satisfactory results if the pigs are allowed free range and so enabled to supplement the diet by other foods which they root up when foraging. For pigs which are kept confined in sties this diet is not quite adequate. It supplies all the protein fat and carbohydrates required, indeed rather too much fat, but it does not supply sufficient calcium and iron. The rate of growth of young pigs on such a diet is often slow and older pigs often develop stiffness on the joints which is usually attributed to rheumatism. This slow growth rate and stiffness are both symptoms of calcium deficiency and indicate the desirability of supplementing the diet with calcium. This can be done by adding the mixture of salt and limestone mentioned above at the rate of 3 lb. of the mixture to each 100 lb. of *poonac*.

For horses: Coconut *poonac* is seldom or never fed to horses in Ceylon, but it has been used in other countries with satisfactory results. It may be substituted for oats in approximately equal quantities.

It is not likely to prove a good food for race horses, but could safely be used for hacks and polo ponies.

For poultry : Coconut *poonac* is not suitable to form any considerable proportion of the diet of laying hens because of its fattening properties. This applies especially to hens kept in confinement. It may be used to supplement other foodstuffs but should not form more than 10 per cent of the mash.

For young growing cockerels it may be used more freely and for such birds it is a useful food.

Summary

To sum up we have in coconut *poonac* a very valuable foodstuff suitable for many classes of livestock.

Livestock owners can use it more largely than in normal times and should bear in mind when doing so its special qualities as described above. The main points to bear in mind in order to get the best results from coconut *poonac* are as follows :

(a) Do not store it in a place where it may become damp.

(b) Remember that while it is rich in other food constituents, coconut *poonac* is not a good source of calcium. Therefore give along with it either some food which is rich in calcium for example, gingelly *poonac* or *dhal* husk or add a mineral mixture containing calcium.

(c) Do not use coconut *poonac* too liberally for laying hens especially which are confined to small runs.—Reproduced from the *Bulletin of the Indian Central Coconut Committee*, July 1948.

FODDER RUSHED TO SCARCITY-AFFECTED AREAS

THE Government of India have assumed responsibilities for the purchase and supply of fodder to scarcity-affected areas in Cutch and arrangements are being made to rush fodder to affected areas. Already 10,000 tons from Central Provinces and Berar have moved and shortly substantial quantity from Bhopal may reach the area.

The relief measures suggested are two fold :

(a) The removal of unproductive cattle for the period of famine to places in other parts of India where grazing is plentiful.

(b) Immediate supply of sufficient quantities of fodder at subsidised rates and concentrates at cost price to the cattle owners.

A scheme of internal distribution of fodder has been worked out and full use will be made of 23 existing *pinjrapoles* which are well-distributed all over Cutch to serve as centres for collecting abandoned cattle and distribution of fodder. The work will be entrusted to a Committee set up for the purpose.—*Food Bulletin*, January 31, 1949.

Book Reviews

SOIL AND WATER CONSERVATION IN THE PUNJAB

By R. MACLAGAN GORRIE. (Published by the Forest Department, Government of the Punjab, 1946, pp. 290, Rs. 5 or 7s. 6d.).

THIS book reviews the contribution of researches done in India and elsewhere specially in U.S.A. on the soil erosion problems. Some of the chapters have been written specially on the existing conditions in India with a special reference to the Punjab before partition of India, and the author, with his many years of experiences in India, has discussed particularly his own work and suggested very useful and practical measures to overcome the ever-increasing danger of erosion and the reclamation of *chos* areas in the Punjab. A few other chapters are of sufficient scope that could serve as a part of a text-book on soil conservation. The accomplishment of the work on soil conservation in the Punjab has been described clearly and in a scientific manner but the author occasionally digresses to bring some fundamental aspect of soil and its engineering properties. The format on the whole is good and the photographs and many figures and drawings are legible and are quite useful to follow the text.

In the first chapter the author has shown in short how the soil erosion begins to damage our soil right from its very formation commonly known as normal erosion up to the accelerated erosion caused by human interference with a brief reference to the importance of humus in developing a stable soil structure, on which depends the erodibility of a soil. He has also referred to the manner in which water is held in soil and how it is lost causing the surface run-off. The agency causing the erosion and the forms in which erosion affects the soil are also discussed in this chapter.

The second chapter deals only with the importance of control methods at catchment area and also the down-stream control. A short summary of erosion control methods classified by the functions is given at the end of the chapter.

In the third chapter the importance of contouring in controlling the run-off in heavy rainfall areas and the conservation of all available moisture in areas of low rainfall is brought out. The author has also stressed the importance of the accuracy of alignment of different forms of contouring, viz. broad base furrow of America, the Bijapur bunds and *watt-bundi* in the Punjab, and has shown how the improper construction of these ditches and furrows may add to the erosion rather than stop it. The slopy lands need a plant cover and in India the choice of crops is a bigger factor ; the consolidation of scattered holdings and the partition of undivided *Shamlat* also require attention.

A schedule of *watt-bundi* based on American data but altered on the basis of contouring demonstration in the Punjab has been given. The author with his experience has been able to suggest how the *watts* and spillways should be built on sandy and porous soils as well as on heavy soils in which sandy outlets should be planted with *dub* grass and steep slopes or hills with *bhabhar* grass. A reconnaissance survey for preparing terrace includes the study of the classes of soil, the slope, the natural drainage channel and also their sub-division into terracing compartments between main water-escapes. For preparing terraces at the top of any plateau the importance of diversion ditch and also the drainage outlet is stressed.

The fourth chapter deals with the prevention of erosion of grass land. The partial closing of grazing grounds in the Punjab for over 35 years has failed to gain the objective and so the author feels that over-grazing of pasture could be avoided by taxation of *bona fide* cultivators in respect of surplus animals. He further suggests that the improvement of grazing practices, the upgrading of cattle, the introduction of stall-feeding depends upon the grass we can produce from waste land. This phase of soil conservation, according to the author, is very important. The food value of grasses for making hay is also to be improved to enhance the nutritive value of feeding stuff.

Notes on the habit of some of the grass species are described in this chapter. The Table on page 74 giving the American figures for the acreage required per head of livestock under different conditions of rainfall is of considerable value and shows how we neglect our waste land by over-grazing when the capacity may be so less as to have one animal for 60 to 200 acres in 5 to 10 in. rainfall area.

In the fifth chapter the author has described the importance of building the fertility of soil and the part played by the vegetative cover in preventing the evaporation and maintaining high humidity.

Run-off and erosion from snow-fall and snow fields have not been much appreciated in India although the contribution that they make in the Punjab rivers is of tremendous importance. The importance of crumb structure and the green manuring to conserve the soil moisture is again stressed.

The sixth chapter deals with the run-off, its measurements and the control. In this chapter the author discusses the apparatus used to measure run-off under different vegetation. He has suggested the maintainance of *watts* and *bunds* to control rats and also the plugging up of *gullies* properly. In the preparation of check dams the author suggests the drop system to get full benefit of check dams; these check dams could be made of brush wood, wooden crates, wire-bound rocks. The check dams should have spillways. The author emphasizes that isolated bunds put down here and there without forming a part of a definitely planned and comprehensive project are just a waste of money. Some patterns of spillways are illustrated in this chapter.

In the seventh chapter the author has discussed some heavy implements like bull-dozers, excavators, and scoops, which could be used for heavily damaged lands like ravines.

In Chapter VIII the necessity of having diversion ditches and contour trenches to conserve more water is explained.

Chapter IX deals mostly with the flood erosion which forms a problem in India. In this connection the hydrological data given on pages 190-191 of the catchment areas in India and in America are useful.

In Chapter X the use of grasses to protect the stream bed is shown and complete details of torrent reclamation right from driving a post up to the plantation of different selected grasses have been given.

Chapter XI deals with the neglected aspect of river banks. The enormous stretches of sandy waste land along the banks in the plains should be protected by afforestation.

Chapter XII deals with wind erosion with special reference to India and the author has shown how the ecologically stable forest is being destroyed to make way for cultivation on the border of desert where fertility dwindles until the land is merged into adjoining desert. The records of sand movement have shown that shifting sand has increased at an alarming rate and the desert conditions and shifting sand are advancing at a rate of half a mile a year. He suggests the use of annual legumes to establish plant growth on such dunes.

In the last chapter the author remarks that a better coordination of farming practices and a more intelligent use of the land is a better way to solve the soil erosion problem. He also describes the objectives and the methods of Soil Conservation Service in America and suggests that in India a demonstration project comprising of at least 100 sq. miles would be good enough for each region. The first step towards understanding the erosion problem is in having a complete survey of the area and aerial survey as in America is also suggested. The author thinks that due to lack of trained personnel at least ten years will be required to complete the project.

Since the control of soil erosion is not the job of a forester alone or an engineer alone, the author suggests the establishment of a Board of Land Utilization wherein the Soil Scientist, Agronomist, Forester and Engineer can pool their knowledge together.

In the Appendix the Punjab Land Preservation Act is given. (R.V.T.)

GOOD CROPS FROM POOR LAND

By W. A. ROACH

LARGE increases in yield, as a result of soaking cereal seed in suitable nutrient solution before sowing in nutrient-deficient soil, were obtained on the experimental scale by Mrs. W. O. Roberts, a member of a team set up by Britain's Agricultural Research Council to work on the diagnosis and cure of mineral deficiencies in plants.

The work had two objects. First, to find out whether it was possible to introduce into the seed enough of the major nutrients, phosphorus and potassium, in a readily available form to carry the young plant through its early stage before its root system was sufficiently developed to make full use of available supplies of these nutrients in the soil, and secondly, to discover whether the same would apply to trace elements on soils known to produce trace element deficiencies.

The most important result was obtained by soaking oats in about one-third of their weight of 21 per cent tribasic potassium phosphate (K_3PO_4) solution, and sowing in soil known to be deficient in phosphate. The yield from untreated seed was 17, from water-soaked 20, and from phosphate-soaked, seed 25 bushels to the acre; and there were correspondingly large increases in straw. This was equivalent to using 3·4 pounds P_2O_5 per acre, of which no less than 73 per cent was recovered in the harvested grain, suggesting a high degree of efficiency of utilization of phosphate. In another experiment on oats, phosphate was found to be more than seven times as efficient when soaked as when sown with the seed, and in an experiment on wheat it was 60 times as efficient. Large increases in yield were also obtained in barley.

It must be emphasized that these hopeful results were on an experimental scale and that the process has not yet been applied on the large scale. There are certain conditions that have been found to be essential for success, and a warning must be given that unless these conditions are satisfied the grain may easily be damaged or killed.

The volume of solution must be so chosen that all of it is absorbed within 24 hours. When grains are soaked valuable substances are extracted by the water or solution and unless the solution is absorbed completely they are lost and the grain is consequently damaged. Cereal grains absorb about one-quarter of their weight of water or nutrient solution.

The soaked seed may be sown broadcast by hand without drying, but if this procedure is adopted the wet grain must be sown immediately because it soon 'heats' when stored in a heap when moist.

If the seed cannot be broadcast immediately after soaking, or if it is to be sown by drill, it must be dried. The safest drying method is to expose the grain in a thin layer to a current of dry air at normal temperature with frequent turning. If artificial heat is used it is most important that the temperature must not rise above 22°C. in the early stages because grains are particularly susceptible to heat injury when moist. The grain should be dried to its original weight; excessive drying is to be avoided.

When soaked grain is dried to its original weight it will be found that it has increased in volume by about one-third. Allowance must be made for this when adjusting seeding rates.

The choice of the most suitable compound of the nutrient element to be used in solutions for soaking seeds is important, and it was found that some compounds are to be avoided. For example, all ammonium salts which tend to be poisonous—while there appears to be a particular compound which is the best for each of the cereals. In the case of phosphates, the best form for oats is tripotassium phosphate (trisodium phosphate seemed equally good when there was no soil deficiency of potassium). For wheat, potassium di-hydrogen phosphate seems best, used at a concentration of five per cent, and for barley, di-potassium hydrogen phosphate at 17 per cent. Large increases in yield were obtained by soaking the three cereals in the three solutions mentioned, but it will be noted that all three contain potassium, to which part of the increases may have been due. If phosphate alone is required, the obvious choice, as being easily obtainable, would be triple superphosphate, but unfortunately an experiment with this form of phosphate became water-logged, and its suitability was not established.

The 'soaked' nutrient is held in the outer layers of the seed, where it is readily available to the rootlets of the developing seedlings, but it is readily dissolved out again if the grain is subjected to excessively wet conditions, consequently soaked seed is likely to give better results on well-drained, than on poorly drained, soils, and may be ineffective on a water-logged soil.

The greatest future for seed soaking may well be on soils that are not only deficient of phosphate but also fix any phosphate added to them in a form that is unavailable to the plant. Phosphate soaked into the outer layers of the seed is largely protected from this soil fixation and, as already stated, is readily available to the rootlets of the developing plant. There are vast areas of such phosphate-deficient soils that also fix phosphate added to them. The extremely efficient uptake of soaked phosphate into the plant leading to large increases in yields in relation to the phosphate used, already mentioned, suggests that the method is well worth trying in the many areas of the world where phosphate has to be transported over great distances.

In the time available only a few experiments could be carried out to see how far micro-nutrient deficiency could be prevented by seed-soaking. One experiment proved quite clearly that soaking seed in manganese sulphate before sowing in manganese-deficient soil resulted in the seedling remaining green and healthy some weeks after those from untreated seed had died. Some soils are so deficient in manganese that seedlings die soon after the first leaf appears above the surface and before spraying can be effective. The results of the experiment just mentioned suggested that on such soils seed-soaking might well carry the seedling through this early critical stage until there was enough leaf development for manganese spraying to be effective.

Mrs. Roberts has written a more detailed account of her work for a number of Britain's *Journal of Agricultural Science*. It is to be regretted that circumstances made it impossible to continue the work beyond the experimental stage to full scale field trials, especially as it suggested the possibility of very large economies in the use of phosphates and perhaps also potash, together with increases in yield, and pointed to a possible new way of dealing with trace element deficiency problems. (*B.I.S.*).

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INDIAN FARMING

MARCH, 1949

Vol. X

No. 3

AGRICULTURAL WEALTH AND INDUSTRIAL PROGRESS*

SOME days ago my friend the Hon'ble Mr. Patil, your Minister for Agriculture, asked me to be present at this function and I agreed to it without any hesitation. As a matter of fact, I was myself desirous of being present here on this occasion. Today's function has an importance of its own. A little over a year ago, we gained our political freedom and simultaneously our land was partitioned. Both political freedom and this physical partition of our country has left us with big tasks. The masses want to reap the fruits of freedom particularly in the economic field. The people's Government is eager to plan and work for that end. It is anxious to reconstruct a happy and prosperous India. This happiness and prosperity is linked inevitably with agricultural wealth.

A country like India where for long a majority of its people must live and labour in villages, prosperity can have no meaning unless our fields and farms yield us their full fruit and enrich the tillers of the soil and thereby the country. It is the agricultural wealth of countries like the United States, Canada, Australia and Russia which has made their people prosperous and given them the means for achieving national prosperity. Agriculture is the mother of industry. We must have a healthy and robust mother if its child is also to be robust and healthy. Agriculture must, specially in a country like ours, have the first place in national economy. More of national attention, national energy, national finance, both through the Central and the Provincial and State Governments, should be diverted to the fulfilment of our task in the field of agriculture.

We need not confine ourselves to the goal of mere self-sufficiency. Maximum agricultural production is to be the foundation of our industrial development. Vast masses must have adequate purchasing power to constitute the home market for the products of our fully developed industrial activity. India cannot imitate those nations who maintain their industries by exploiting and dominating colonial countries. The 35 crores who make up India can sustain an expanding industrial activity if only they created out of the mother earth adequate purchasing power for themselves.

But this great task of developing agriculture cannot be fulfilled unless the millions who work on the fields give their fullest cooperation. We have not all of us yet realized that if partition enabled us to achieve political freedom, it has led to economic consequences which are not all to our advantage. The partition of the country has left us with great shortage in some of the most essential commodities. We are short in food, short in cotton, short in jute and short in a number of other vital things. In all these we must have the goal not of self-sufficiency but of abundance and plenty and yet we are starting with initial handicaps. It has been estimated that as a result of partition, we in the Indian Dominion have to maintain about 78 per cent of the population of undivided India. To our share came also only 70 per cent of the rice area and 64 per cent of wheat area and on this we have to maintain 78 per cent of the population.

The partition has also placed us under another serious drawback. Having allotted 78 per cent of the total population to our Dominion, we were given only 65 per cent of the area under irrigation and dependable supply of water for our crops and only 54 per cent of irrigated wheat area. In our Dominion so far as also the States are concerned, huge areas of uncultivated and unirrigated lands have fallen to our share. A very disproportionate area of land has thus to depend upon the vagaries of the weather and the uncertainties of the monsoon. Human effort spent on field operations is deprived of its fruits if Nature does not bless it with its merciful showers. And so in proportion to population, over a wider region than before partition, our crops have to face uncertainties. The reverse is the case with Pakistan. Its provinces and States have to maintain proportionately less population and greater area of cultivated and irrigated land.

---

* Speech delivered by Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, Government of India, while inaugurating a 10,000-acre land reclamation by tractors at Patharia, Central Provinces on 5 January 1949.

India, agriculturally, has thus to start with a great handicap. A year or two's efforts in a normal way can effect no radical change where our chief means of agricultural production, land and water, have both shrunk materially in proportion to population. Since August 1947, our great task has been to produce out of less land and still less irrigated land enough food to feed a greater proportion of population. But, however, big the task, it has to be fulfilled and however great the difficulties, they have to be overcome.

It is for the fulfilment of this task and for overcoming all these difficulties that your own people's Government in the country wants the cooperation of all of you. I would like the agriculturists of the Central Provinces to realize the opportunities which are being given to them to tender this cooperation. There are vast tracts in your Province which have become infested with weed and which today can yield nothing either to you or the country. It has been estimated that in your Province six lakhs of acres are in this condition. The Central Government with the full cooperation of your Provincial Government is trying to reclaim this large unfruitful area for you and the country.

Today about 100 tractors sent from Delhi are ready for fresh operations so that in place of being over-run by unsightly weeds we may see the fields of your Province laden with health-giving wheat. These six lakhs of *kans*-infested lands of your Province is only a little bit of the huge area of 6½ crores of acres of cultivable waste land which we have inherited as our share when freedom was won and partition effected. To convert all this stupendous area of cultivable waste land into smiling fields of corn is a mighty problem which must occupy several years. But we have planned an immediate programme of reclaiming about one-tenth of this area in the immediate future. Forty lakhs of acres infested with weed or *kans* or *hariali* in the Central Provinces, the United Provinces and Bombay and the States of Madhya Bharat, Vindhya Pradesh and Bhopal are to be immediately reclaimed. Besides this area there is other uncultivated waste land not infested by any harmful weed which also has been included in the present programme. This would cover another 22 lakh acres. Thus a total area of 62 lakh acres is intended to be included in a programme which beginning towards the end of the present year is expected to be completed in the course of about six years. Every season thus, new land will be coming under the plough and yielding us badly needed foodgrains in an increasing measure from year to year.

In this scheme of reclamation, 14 lakh acres are to be ploughed up in Madhya Bharat, 10 in United Provinces, 9 in Central Provinces and 5 each in Bombay, Orissa, East Punjab, Bhopal, Vindhya Pradesh and 4 lakhs in East Punjab States. All this will require investment of large funds and great supply of technical personnel and considerable organizing effort. As regards the funds, it is proposed to borrow the necessary finance from the International Bank. We have been consulting the Provincial Governments with regard to this big scheme and it is hoped that it will be finalized in its main outline at Delhi in the course of the next few weeks.

All this land is beyond reclamation by human labour. The aid of science and mechanical power is inevitable if these 62 lakh acres of potential wheat-growing fields are not to continue to reproach us daily with their barrenness, while the whole of India is asking for more food and we have to take round the begging bowl to a dozen countries, big and small, and ask for food even at high prices and sacrifice, hard-earned money and exchange currency, both of which we can ill afford. This does not mean that other measures have not to be taken to step up production in existing fields all over the country. Intensive action in regard to irrigation, improved seeds and manure is essential if immediate results are to be achieved.

To those who are administering the Government of this Province, whether from its headquarters or in the districts or villages and also to the lakhs of *kisans* who will cultivate the land we are now going to plough up, my appeal is to feel that while implementing this programme, they are all participating in a great national effort to help India to reap the fruits of political freedom, that they are playing their part in terminating the econmic bondage of our country as a beggar of food and that they are, by producing more food, contributing to make India healthy and prosperous.

You, the administrators and peasants of the Central Provinces, will be developing your own Province and moving forward to the time when the Central Provinces will become the granary of India. Your Province has great potentialities, agricultural and industrial. But I venture to suggest to those who are shaping the policies of this Province to look upon the role of Central Provinces as a granary of India as in no way less important than as a region of vital industries of the country. Let the agricultural wealth be, as in the United States, the foundation of your industrial progress. For a Province to be wealthy, the vast masses of its people should first be wealthy. It is, therefore, essential that the masses who are spread out in the countryside should be enriched by developing the agricultural resources to the maximum and taking out of the land, both old and new, twice and thrice the yield which they give today and thus double and treble the wealth of the rural population.

I have no doubt that the Government and the people of Central Provinces will formulate and implement such plans as are for the people's ultimate good. As you know, agricultural production is almost wholly the function of the Provincial authority and the Central Government has little scope for executive action in this field. The food problem has the importance of a war problem. But it is the provinces which have to wage this war. To the extent that the provinces put their shoulders to the wheel, to that extent will India free herself from the economic bondage and move forward towards the goal of abundance in food and other agricultural production. And, may I on today's occasion, ask the peasantry of Central Provinces to make and declare their determined resolve that they will show by day to day action that they are fully behind their Government in its plans for the development of agriculture in their Province.

LITERATURE ON INDIAN WOOL : A REVIEW

By A. N. GULATI

WOOL appears to be the most ancient fibre utilized by man for textile purpose. It was known to all ancient civilizations, such as Mexican, Egyptian, Sumerian, and even to pre-Aryan Indus civilization. In Aryan literature, wool can be traced to an earlier age than cotton. Wool continued to be utilized wholly by hand spinning and hand weaving in India until late in the nineteenth century. From this date to the present, the Indian woollen industry has struggled hard to sustain itself through vicissitudes of depression and foreign competition by the aid of Swadeshi Movement, and the Government of India demands during World Wars I and II.

With the foothold gained during the World War II, this industry looks forward to forge ahead. A few preliminary steps taken so far are as follows : (1) Indian breeds of sheep have been surveyed and their stocks and yield have been determined ; (2) the quality of wool from each of these breeds is assessed and (3) experiments have been carried out not only to determine the cost and return of marketing clean and graded wool, but also to improve the stock of sheep both by selection and cross-breeding.

The quality of the bulk of Indian wool is somewhat poor. Nearly half of the total quantity produced is exported, and most of the rest is utilized in making coarse fabrics, carpets, rugs, and blankets. The task of improving the total population of 50·9 million sheep, with a view to supplying the demands of about 300 million people for woven and knitted fabrics, hosiery, carpets and blankets, and to further bring better returns to the sheep farmer, though herculean, is nevertheless, very desirable.

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It is proposed to review the literature on the features mentioned above in what follows, and further to offer suggestions for the consideration of the workers engaged in the improvement of Indian wool.

Historical

Dress is essentially protective in its primary function, the earliest articles of dress being skins, furs, leaves, and barks. While the Bible mentions the fig-leaf as the first article of dress worn by Eve, the Rig Veda records cow, sheep, goat, and deer skins as articles of dress of the ancient Aryans. The warmth-giving function of wool to sheep must have been observed very early for its adoption in human wear.

According to Marshall[1] cotton and woollen clothes were used by pre-Aryan inhabitants of the Indus Valley over 5,000 years ago. Gulati and Turner[2] analyzed a piece of cloth sticking to a silver vase excavated from Mohenjo-Daro, and found it to be made of cotton similar to a coarse type of *arboreum* cottons known today. It appears that the use of woollen cloth is inferred from the discovery of sheep skeleton among the bones of other domestic animals both at Harappa and Mohenjo-Daro[3]. Mackay[4] is, however, of opinion that the numerous spindles and spindle-whorls found at Mohenjo-Daro although indicative of a keen interest of the people in spinning as a domestic occupation, were used most assuredly to spin cotton, and the majority of them were too small and light to spin an elastic fibre like wool.

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[1] Marshall (1931). *Mohenjo-Daro and Indus Civilization*, London.

[2] Gulati and Turner (1929). *Jour. Tex. Ins.*, Manchester.

[3] Baini Parshad (1934). *Proc. Ind. Sci. Cong.*

[4] Mackay (1935). *Indus Civilization*, p. 138, Lovat Dickson and Thompson Ltd., London.

It is interesting to note that the use of wool was known to the parallel civilization of the Sumerians[5]. Lydekkar[6] states, '*Ovis aries* was one of the earliest animals brought under subjugation by man', for instance by the prehistoric inhabitants of Lake-dwellings in Switzerland, who brought it from the East. It is depicted among the earliest of the Egyptian monuments (1449-1423 B.C.) and its remains were mummified by the inhabitants of the Delta during Pharaohnic epoch, by which date there is evidence that two distinct breeds were already known. Speaking about the evolution of sheep Prof. J. C. Ewarts[7] stated, 'that though flocks of sheep fed on the great plains between the Ganges and the Jumna at the beginning of the Pliocene period—over a million years ago and the horn core of a sheep was found in the Norfolk forest bed, formed half a million years ago, it was not until about 7000 B.C. that domestication took place'.

Motichandra[8] writing on the history of Indian costume points out that after the destruction of the Indus civilization and up to the age of Rig Veda, i.e. between 2500 to 1500 B.C., there followed a long gap in our knowledge of textiles. There are neither ruins, nor remains to bridge this gap. The Aryans are believed to have migrated into India between 2000 and 1400 B.C., and it is held that they did not know the use of cotton then. They, however, knew the art of spinning wool and weaving woollen cloth as is indicated by the occurrence of such words as *Avika*, meaning wool of sheep, and *Avi* and *Urnwati* meaning the bearer of wool, i.e. sheep. Wool from Gandhara and the valleys of the rivers, Indus and Ravi, is mentioned in the Vedas. Rig Veda also mentions looms, warp, and the word *kambala* for the woollen garment of the God Pooshan of weavers and shepherds; while the Atharva Veda mentions *dursh*, an equivalent of the modern word *dhussa* for coarse blankets. White woollen cloth called *pandu* to be worn by kings, is mentioned in *Maitrayani Samhita* and *Shathpath Brahmana;* while the word *aruna* for wool is mentioned in *Gobhila Grhyasutra* in connection with cloth made of wool[9].

Laws of Manu (800 B.C.) enjoin a *vaish* (trader) to wear a sacrificial string of woollen threads. The exact translation by Max Muller (1886) reads as below:

'The sacrificial string of a Brahman shall be made of cotton, shall be twisted to the right, and consist of three threads; that of a Kshatrya of hempen threads; and that of a Vaisya of woollen thread'.

Both the *Ramayana* and the *Mahabharata* mention woollen clothes from the Punjab and Gandhar. Bharat, the brother of Rama, was given a number of *kambala ajinas* as presents by his maternal grandfather. Superior shawls of fine texture and warmth were known. *Sabhaparva* of *Mahabharata* further records that the Punjab and the North-Western Frontier Province were well known for their woollens and skins. Trade articles coming from Tajikstan (Kamboj), Parisindhu, China, and some hill-tracts included woollens, pashmina, namda, and skins of sheep and goat.

Kautilya's *Arthashastra* (300 B.C.) describes woollen fabrics known then in the following words:

'Blankets made of sheep's wool may be white, purely red, or as red as lotus flower. They may be made of worsted threads by sewing (*khachita*); or may be woven of woollen threads of various colours (*van-chitra*); or may be made of different pieces (*khandasanghatya*); or may be woven of uniform woollen threads (*tantuvichhinna*).

'Woollen blankets are of ten kinds: *kambala* (a coarse blanket), *kauchapaka* (worn by cowherds), *kulamitika* (head dress), *saunitika* (a covering for the back of the bullocks), *turagastrana* (a spread for the back of a horse), *varnaka* (coloured blanket), *talichhaka* (a bed-sheet blanket), *varvana* (a coat), *paristoma* (a large blanket), and *samantabhadraka* (a cover for the back of elephants).

'Of these that which is slippery (*pichhila*) as a wet surface, possessed of fine hair, and soft is the best.

'That blanket which is made up of eight pieces and black in colour (*bhingsi*) used as rain-proof likewise is *apasaraka;* both are products of Nepal.

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[5] Evans (1932). *The Junior Outline of History*, p.46, Denis Archer, London.

[6] Lydekkar (1912). *The Sheep and its Cousins*, Allen and Unwin, London.

[7] Ewarts, J.C. (1924). *Jour. Tex. Ins.*

[8] Motichandra (1939). *Bharatiya Vidya*, Vol. 1.

[9] Sacred Books of the East, Vol. 29, II, 210.

'*Samputika* (trousers), *chaturasrika* (a rectangular blanket measuring nine *angulas*), *lambara* (a curtain or wrapper), *kalavanka* (same as last but of coarse threads), *pravaraka* (a variety of the last), and *sattalika* (carpet) are made of the wool of wild animals.

'That which is manufactured in the country Vanga is a white and soft fabric (*dukula*), a fine fabric; that of Pandya manufacture is black and soft as the surface of gem, and that which is the product of the country Suvarnkudya, is as red as the sun, as soft as the surface of the gem, woven while the threads are very wet, and of uniform (*chaturasra*) or mixed texture (*vyammisravana*).

'Single, half, double, treble and quadruple garments are varieties of the same, etc.'

Beside sheep's wool, a blanket from the feathers of owl, and garments made from human hair and horse hair are mentioned in *Brahmanas*.

It appears that from this period onwards Indian textile industry advanced only to perfect the cotton manufactures, and the woollens remained at a standstill for all practical purposes. It is only after the advent of the Europeans that Western methods of manufacture including the knitting were introduced into the country. During the Moghul period when the cotton textiles had reached the zenith of their glory, high class woollens were imported from Europe as is evident from the following passage appearing in *The Cambridge History of India*[10] edited by Sir Richard Brown: 'The chief imports into India in Moghul times were silver and gold, copper and lead, high class woollen clothing (for which Europe and notably France was the chief supplier), etc.'. Thus for two thousand years following the Maurya reign, there was no noteworthy progress in the manufacture of woollens in India. According to M. Dauvergno[11] (long connected with shawl trade), the shawl dates back to the time of Emperor Baber. The Moghul Emperors wore on their turbans a jewelled ornament known as *jigha*, shaped like an almond on the top of which was an aigrette of feathers. An *andijani* weaver imitated the design of the *jigha* on a scarf of Emperor Baber so successfully that it became fashionable in all scarves and shawls. These weavers were brought to India and taken to Persia too. The *jigha* is represented in Persian carpets. From this account in which several varieties of shawls embroidered with silk and gold thread and having floral designs are also mentioned, it appears that floral designs and embroidery with silk and gold threads on woollens were introduced during the Moghul period.

Sources of wool and breeds of goats and sheep

Wool is essentially derived from sheep, but a few goats and camels are also well-known sources of wool. One of the finest Indian wool called *pashm*, is obtained from *ibex*, a Himalayan goat. Sir George Watt in *The Commercial Products of India* (1908), mentions the following species and varieties of goats and sheep which yield wool.

Goats: 1. *Capra sibirica* Blanford, the Himalayan *ibex*, is distributed from the central Asian Altai range to the Himalayas in the high altitudes close to perpetual snow. It is much sought after in Kashmir for its under fur, which is known as *asli tus*, or *pashm*. Shawls and fine cloth called *tus* are made from it. The domestication and the hybridization of *ibex* with other tame goats is not known. However, *pashm*-yielding domestic goats of Alpine tracts are considered to be derived from *ibex* or some closely allied extinct species. Even the hair of *ibex* are used for making *pattus*, or coarse cloth suitable for coating and tentage. Watt is of opinion that *ibex* can neither be acclimatized successfully in the Kashmir Valley, or the southern slopes of the Himalayas, nor can produce a useful hybrid with Angora goat. He further suggests that if India needs supplies of *pashm*, the domestication of *ibex* may be tried in Ladakh, Nepal or Bhutan.

2. Among the domestic breeds of goats, which are incidentally descended from a wild species *C. aegagrus* found in Baluchistan and Sind, the recognized breeds are Hill, Nepal, North Indian, Bengal, Surat, and South Indian goats. Out of these it is the Hill goat only which yields some wool, and the rest bear hair only. Beside these, Syrian goats which pass off as Angora goats are also met with in India. Among the four Himalayan breeds

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[10] Cambridge History of India (1937), Cambridge University Press, Vol. IV, 377.

[11] Lawrence (1896). *The Valley of Kashmir*, Oxford University Press.

of Hill goats, three, which have a sub-fleece of wool, are *Changra*, *Chapu*, and *Sinal* or *Singal*. *Chapu* has the finest fleece, while *Changra* and *Sinal* follow in turn in respect of quality.

Sheep : The origin of the Indian tame sheep is unknown, although the ancestors of sheep in general, and notably of the peat sheep of Europe, are the wild urial of the mountain ranges between Persia and Turkestan, and the red mouflon of Mesopotamia[12]. The wild species found in India are : (i) *Ovis nahura*, which appears to be intermediate between goat and sheep ; (ii) *O. hodgsoni ;* (iii) *O. pali ;* and (iv) *O. vignei*. The last named is able to breed freely with tame sheep, and is considered to have contributed to some extent to the origin of domestic breeds of Indian sheep. This species yields some *pashm* called *thosh*, and its hybrid with the *dumba* while young, also yields *pashm*. The *dumba* is said to be derived from both the Afghan and Egyptian stocks. Its existence in India was recorded by Aelian in 250 A.D.[13].

The following breeds of domestic sheep are listed by Watt (1908) and in *Report on the Marketing of Sheep and Goat in India*[14].

Watt (1908)

1. Patna
2. Madras
3. Coimbatore
4. Mysore
5. Deccani
6. Nepal
7. Kashmir
8. Himalayan
    - (i) Barual
    - (ii) Silingia or Peluk.
9. Tibetan
    - (i) Hunia
    - (ii) Haluk.
10. Hira
11. Dumba

Marketing Series No. 50, 1943

1.	Ganjam	Orissa
2.	Nellore	Madras
3.	Bellary	,,
4.	Coimbatore or Karuba	Madras
5.	Hassan	Mysore
6.	Mandya	,,
7.	Karnah	Kashmir
8.	Gurez	,,
9.	Bakarwal	,,
10.	Bhadarwah	,,
11.	Chantham	,,
12.	Balkhi	N.W.F.P.
13.	Damani or Lama	,,
14.	Hashtnagri	,,
15.	Kaghani	,,
16.	Tirahi, Parai, or Afridi	,,
17.	Waziri	,,
18.	Bibrik	Baluchistan
19.	Dumri or Harnai	,,
20.	Bagri	Punjab, Muttra, Bharatpur, Alwar
21.	Biangi	Punjab, Kangra
22.	Lohi, Lamochar	,,
23.	Thal	,, west
24.	Bikaneri, Jangli, or Buchni	Rajputana, U.P.
25.	Bundhelkhandi	Central India
26.	Dhamdra	Central Provinces
27.	Godavai	C.P. and Hyderabad
28.	Deccani	Bombay & Hyderabad
29.	Kathiawari	Kathiawar
30.	Kooka	Sind

Sheep population of India

It would be interesting to know the population of each breed of sheep found in India with a view to assessing the quality of wool available from each type. Such a census will also incidentally permit an easy estimation of the quantity of various grades of wool, which is generally associated with the breed. It will also furnish the starting point of work intended to increase the number of desirable breeds, and discourage the multiplication of sheep producing coarse wool. However, the data available at present are (i) province-wise, (ii) sex-wise, (iii) age-wise, and (iv) quality-wise. The province-wise statistics[15] are given in Table I.

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[12] Ewarts, J.C. (1924). *Jour. Tex. Ins.*, pp. 582-83.

[13] *De Nat. Hist. Anim.*, IV, 32.

[14] *Report on the Marketing of Sheep and Goat in India* (1943), Marketing Series, No. 50, Government of India Press, New Delhi.

[15] Vaidya and Bhatt (1947). *Current Science*, XVI.

TABLE I

Annual production of wool in India in 1940

Area	No. of sheep (lakhs)	Yield of wool per sheep (lb.)	Annual yield of wool (lakh lb.)	Percentage
		Greasy basis		
1. Kashmir ...	12·5	1·5	18·5	2·2
2. N.W.F.P. ...	8·4	3·4	28·3	3·3
3. Baluchistan States ...	15·1	3·2	48·6	5·7
4. Sind and Khairpur State ...	7·8	4·0	30·9	3·6
5. The Punjab ...	44·2	3·8	169·7	20·0
6. Punjab States	13·6	3·8	52·3	6·2
7. U.P. and States	22·0	4·3	75·1	11·2
8. Rajputana and States ...	53·2	3·1	164·7	19·3
9. Western India States ...	12·5	3·7	46·3	5·4
10. Bombay and States ...	21·1	1·0	21·1	2·5
11. Mysore State ...	26·0	0·85	22·1	2·6
12. Madras and States ...	121·4	0·56	69·4	8·2
13. Hyderabad State	59·4	0·56	34·0	4·0
14. Central Provinces	5·8	2·0	11·7	1·4
15. Bihar ...	11·5	0·81	9·3	1·1
16. Orissa ...	4·0	0·75	3·0	0·3
17. Bengal and States	5·1	1·1	6·0	0·7
18. Other areas ...	9·7	2·0	19·5	2·3
Total for India ...	453·3	Av.1·90	850·	3100·0

A perusal of the foregoing data shows that the region, Madras and States, has the largest population of sheep, while Hyderabad State and Rajputana States respectively follow in the order of magnitude of sheep population. Unfortunately the Madras breeds have either no wool as in Nellore breed, or indeed have a poor quality of fibre, which is locally used for making blankets only. Hyderabad has no distinct breeds of any merit of its own; but Rajputana has a promising section of Bikaneri breed, which is capable of yielding medium quality wool. It may be worthwhile to make a joint effort at improving the stock of sheep and the quality of wool by encouraging sheep farming and marketing cleaner wool. Industrial utilization of the local wool can take the shape of a blanket manufacturing industry beside carpet making, which is already a profitable occupation in adjoining districts of the United Provinces.

The sex and age-wise statistics are included in the *Report on the Marketing of Sheep and Goat in India* (1943). Out of a total population of 50,894,000 sheep, 34,103,000 are female adults; 5,486,000 are male adults; and 11,305,000 are the young stock. Ninety-five per cent of the sheep population is met with in rural areas.

The quality-wise statistics put before the Indian Council of Agricultural Research in 1948, point out that out of 26 million sheep in Indian Union, 14 million are hairy, 9 million yield carpet wool, and 3 million produce fine wool. The average requirement of fine wool for Indian Union is 20·08 million pounds, out of which 8·99 million pounds are produced in India, leaving a balance of 11·09 million pounds for import.

It is further interesting to point out in this connection that at the rate of 16 million sheep slaughtered yearly in India, and the production of only 11 million lambs annually, the sheep population is likely to dwindle quickly in this country. While this feature can be taken advantage of in eliminating undesirable stock, it also provides an opportunity for quickly replacing it with desirable stock, and preserving it.

Improvement of sheep stock

Watt mentioned that some attempts at improving Indian breeds of sheep were made during the nineteenth century but without much success. The current literature contains the account of many recent attempts which have been sponsored by the Indian Council of Agricultural Research. India and Pakistan have some sheep breeding stations, where selection and hybridization work has been carried out for some time to improve the indigenous sheep stock. Banihal in Kashmir, Hissar in East Punjab, Poona in the province of Bombay, Hosur in the Presidency of Madras, and Hebbal in Mysore State are some of the places where breeding work has been in progress.

The improvement aimed at consists in not only increasing the average yield of wool per sheep, but also making the wool finer in quality.

Nanda[16] states that selective breeding in Bikaneri breed leads to greater improvement in sheep stock and quality of wool than is possible by hybridization of the local breed with imported Merino stock. He stresses that (a) the use of Merino in the country has a limited scope particularly on the plains and (b) it would be as paying, if not more, on the plains, to improve the quality and quantity of wool of indigenous breeds purely by selective breeding. His observations on selective breeding of Bikaneri and Lohi breeds at Hissar are briefly given below.

Bikaneri and Lohi breeds can be classified into four types, namely A, B, C and D, according to the degree of medullation in their fleece, such that A has 0 to 20 per cent, B has 20 to 40 per cent, C has 40 to 70 per cent, and D has 70 to 90 per cent medullation. The average diameter of wool in these types varies in the following manner :

Bikaneri		Lohi
A 32·2 microns	...	24·2 microns
B 34·9 ,,	...	32·2 ,,
C 37·5 ,,	...	40·6 ,,

Attempts to increase types A and B, and to eliminate types C and D, stretched over a period of three years, gave the following results.

Bikaneri breed : Males in A increased from 5 to 8 per cent, and in B from 11 to 23 per cent ; whereas the females in A increased from 7 to 15 per cent, but in B decreased from 22 to 18 per cent. In the case of C and D, the males increased from 36 to 50 per cent in C, but decreased from 49 to 19 per cent in D ; while the females in C increased from 38 to 41 per cent, those in D decreased from 33 to 27 per cent.

Lohi breed : Males in A increased from 12 to 24 per cent, and in B from 12 to 15 per cent ; whereas females increased from 8 to 22 per cent in A, and 14 to 20 per cent in B. The decrease effected in C and D was from 39 to 35 per cent and 39 to 26 per cent respectively in females, and from 36 to 20 per cent in males of D type only.

Nanda also demarcates India into three zones in respect of the quality of wool in each, as below :

(i) Madras, Bombay, Bengal, Central Provinces, Bihar, Orissa, and part of the United Provinces producing hairy types which contain few true wool fibres.

(ii) Part of the United Provinces, Baroda State, Rajputana, Sind, Bikaner, Bahawalpur State, and part of South-East Punjab producing better wool with higher percentage of wool fibres.

(iii) North-Western Frontier Province, North-Western Punjab, Kashmir State, and Baluchistan producing superior quality of wool.

Haksar[17] points out that efforts made during the last 150 years to improve the local sheep by cross-breeding have been 'stray and unsustained' and expresses the hope that successful crosses like the Hissardale can be produced by crossing Merinos with other local breeds. He observes that out of 146 sheep reported upon by the Bombay University 16 out of 18 sheep classed as fine were either pure Merinos or cross-bred Merinos ; and even among the 21 medium quality sheep, there were three cross-bred Merinos. He considers the selective breeding as slow and impracticable method of improving sheep-stock. He advocates the introduction of Merino blood in local breeds to improve the quality of wool by making it finer and eliminating the kemp and medullation content from it. He deprecates the steps taken to encourage the production of carpet wool only. He further suggests that the objections to the introduction of Merinos, such as short staple wool, and the inability of Merinos and its crosses to stand local conditions, can be overcome by importing long staple Merino varieties, and circumventing the ill-effects of climatic conditions by shifting sheep from regions of heavy rain to drier parts just as is done in Japan, Manchuria, and Australia.

It appears to the writer that the factor involving fecundity and fertility have not received their due share of consideration in planning improvement in quality of wool with quick multiplication of improved stock. In this connection, the British Shropshire breed which is noted for its fecundity, sometimes producing four or even five lambs at birth ; the earless Shanghai breed, which according to A. D. Bartlett, bred twice a year and produced four or even five lambs at a time in the London Zoological Gardens in 1857 ; and the Tunisian fat-tailed breed which produces twins quite commonly and breeds twice a year in favourable conditions, may be considered for introduction into India in place of the famous Merino. The Tunisian variety is mentioned to have been introduced into the U.S.A., South Africa, and Australia for the good quality of its fleece and excellent quality of its mutton. The variable colour of its wool is however a point against it[18]. It is probable that if a survey of known breeds in the world is made in respect of these factors, the choice of breeds for crossing with Indian varieties can be very much widened. In fact some prolific individuals may even be found among Indian breeds which may transmit this quality to its progenies.

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[16] Nanda, P. N. (1947). Improvement of Quantity and Quality of Wool in India, *Indian Farming,* Vol. VIII, No. 1.

[17] Haksar, R. C. (1947). A Method of Improving India's Wool Production, *Indian Farming,* Vol. VIII, No. 1.

An investigation may further be undertaken to trace the history of the evolution of the Merino variety, which incidentally bears all wool and no hair. Ewarts was of opinion that Merino was mainly a blend of the red mouflon of Mesopotamia and the famous Marco Polo wild sheep met with in the Himalayas. The conditions under which the ancestors of the Merino got rid of the outer coat of hair, which is an essential part of the fleece of all wild sheep during winter, deserve to be studied. The knowledge of the conditions may prove helpful in evolving similar varieties of all wool sheep.

With the separation of Pakistan, the Indian Union is bereft of a large part of the best wool-producing regions. In order to be self-sufficient, India has a stronger case than ever before, to develop sheep-farming on the Himalayan range. Tibetan breeds are expected to do well in this region, and, therefore deserve to be tried there instead of the Merino or its crosses.

Quality of Indian wool

Quality of wool depends upon its characteristic structure. Unfortunately no work has yet been done on the structure of Indian wools, notably in relation to the effect of nutrition, minerals, vitamins, and hormones, which have a generally agreed bearing on wool structure. It appears desirable, therefore, not to leave this aspect of improvement neglected any longer.

Wool is a kind of hair, which has many functional modifications. It varies from soft flexible wool of sheep, beard hair of man, horse (mane and tail), sheep (part of the fleece), and goat (generally the whole fleece), brush hair of squirrel, bristle hair on horse and cow-skins, bristle of hog, whiskers of rat and cat, to quill of hedgehog and porcupine, functioning respectively as heat regulator, means of protection against abrasive action of environment including light, tactile organs and as weapon of defence and attack. Wool on account of its heat-regulating function is used as raw material for human clothing. The Sanskrit word *avika* for wool, and *avi* for sheep are derived from the root *av* meaning to guard. Even the generic name *Ovis* for sheep is derived from the same root.

Although wool is often differentiated from hair even on structural basis, yet the distinction cannot be carried too far industrially. Some wools are too coarse for spinning, and some hairs are even softer than wool for the purpose. Industrially, therefore, woollens are not only derived from sheep which alone bear true wool, but also from goats in the form of cashmere and mohair, alpaca, vicuna, and camel hair from animals of the same name.

Sheep bear normally both the true wool and the beard hair, but the amount of the former can be increased by cultural methods to such an extent that some breeds of sheep produce now exclusively true wool. The goats, on the other hand, are not affected by domestication in this respect, and thus continue to grow both coats of hair—soft and coarse.

The quality of wool varies on the same animal in different regions of the skin with age and with health. It also varies with the breed of sheep. The fleece is coarse and hairy in Nellore breed, 60 per cent hairy in Bellary and Khasi breeds, 20 per cent hairy in Damani and Bibrik breeds and 2 to 8 per cent in Hashtnagri, Deccani, Lohi, Masuda, and Bikaneri breeds. The Karnah, Gurez, Hissardale, Pattanwadi, and Khagani breeds are not at all hairy. Among the foreign breeds the Merino has the shortest staple, and the English Costswold has the longest staple (16 to 17 inches). Wool also varies in colour. Lustre in some wools is attributed to certain breeds and pastures. Wool is put to varied uses too. Accordingly grading of wool for different uses is an essential step to its full utilization.

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[18] Lydekkar (1912). *The Sheep and its Cousins*, p. 40 and p. 183.

Grading in respect of body regions is the usual method followed abroad. Its application to Indian fleece is justified by the work of Bruen, Khot, and Deshpande[19] on the Deccani breed. Wool of a sheep is sorted into two grades namely, the body wool, and the skirtings. The latter includes fleece from head, face, neck, parts of belly, legs and breech. The wool in this region is positively inferior to that on the rest of the body. The back bears the finest fibres in the body wool.

Narayan[20] describes the grading procedure followed in Baroda State. The body wool after separation from the skirtings is further divided into (i) withers—long and comparatively coarse fibres, (ii) side, back, and shoulder —the finest fibre, and (iii) breech or short and coarse fibre. He notes that by following this procedure, the prices realized are higher by four annas per pound for the body wool than those for ungraded wool. The wool of Pattanwadi breed according to him is fit for 56's in its finest grade, for 36 to 38's in first grade, and 32's in second grade.

Lamb wool with intact fibre tips is considered superior in quality to the sheared wool. It is estimated that such wool amounts to about 10 per cent of the total shorn from adult animals. Wool from dead animals is also inferior to shorn wool, and so is the lime processed wool from the tanneries. The last two types of wool do not take up the dyes easily.

Apart from this type of grading, the purchaser also looks for a certain standard in the following thirteen properties :

(1) Fineness, as measured by diameter of the fibre, is the most important property which is closely related with the spinning value. This relationship may be illustrated by the following data which are taken from Vaidya and Bhatt[15].

Counts	Diameter (microns)	Counts	Diameter (microns)
100	17·1	56	27·2
90	18·3	54	29·0
80	19·6	50	31·0
70	20·8	48	33·1
64	22·3	46	35·5
60	23·4	40	38·3
58	25·5	36	39·2

These authors also studied the dispersion of diameter values of Indian wools as shown in Table II below and noted that the Indian wools are characterized by a high coefficient of variation in diameter, and as such their spinning value cannot be assessed correctly by the standards given above. They suggest that both the length of staple and the medullation should also be taken into account for judging the quality of Indian wools. The results of tests carried out by them on the wool of fifteen Indian breeds of sheep are given below.

TABLE II

Fibre-properties of Indian wools

Breed	Region	Mean fibre length (mm)	Fineness (microns)	Homogeneity, C. V. of Diameter.	Hairy portion or medullation per cent
Karnah	Kashmir	87	26	22	0
Gurez	,,	63	22	25	0
Hissardale	Punjab	73	24	19	0
Pattanwadi	Gujarat	98	30	27	0
Khagani	Hazara District	62	33	34	0
Hashtnagri	N.W.F.P.	100	25	39	2
Deccani	Deccan	83	36	32	3
Lohi	Punjab	114	39	27	4
Masuda	Ajmer	33	32	31	8
Bikaneri	Rajputana	149	38	24	3
Damani	N.W.F.P.	38	35	34	18
Bibrik	Baluchistan	103	39	31	20
Bellary	Madras	103	52	36	60
Jalauni	U.P. Jalauni District	66	69	43	58
Khasi	Assam	78	66	58	61

(2) Length of the staple of Indian wools ranges from 1 to 5 inches when sheep are clipped twice a year. Length also varies like fineness

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[19] Bruen, E. J., Khot, S. S. and Deshpande, K. K. (1941). Study of Wool Quality as the Basis of Individual Selection in Breeding of Deccan Sheep. *Ind. Jour. Vet. Sci. and Anim. Husb.*, Vol. XI, 3.

[20] Narayan, N. L. (1947). Baroda Wool-grading and Marketing Experiment, *Indian Farming* Vol. VIII, No. 1.

on different regions of the body. Uniformity is prized in this property and so abnormally long portions of the fleece are first trimmed before an animal is sheared. These trimmings go with the short and coarse fibres in the skirting.

(3) Strength of wool is inferior to that of other textile fibres. There are generally two kinds of weak wools, namely, (i) 'tender wool' which is weak throughout the length, and (ii) 'wool with break'. While the origin of the former is due to poor condition of the sheep, the latter is ascribed to a sudden change in the health of the sheep or of its food. This property is obviously associated with the nutrition of the sheep.

(4) Elasticity being high in wool makes it superior to vegetable fibres. This property goes hand in hand with fineness and strength. It is measured in terms of percentage elongation before breakage in a strength test. Quality wools have at least 25 per cent elasticity.

(5) Crimp is the name given to waviness in wool. It is said to be caused by certain physiological changes that take place periodically during fibre growth. Its number increases with increase in fineness and reduction in fibre-length. It is measured in terms of the number of waves per unit length, which usually varies between 5 and 20 according to quality.

(6) Kemp includes fibres which are shed away from skin, are chalky white in appearance, are without lustre, have large diameter, have no strength, and resist dyeing and felting. The wild sheep have a kempy outer coat and a short woolly undergrowth. Presence of kemp is a serious defect in wool. Selective and scientific breeding can restrict it in any flock of sheep.

(7) Hairiness is measured in terms of the number of medullated fibres, which have a dead white appearance, and a central core throughout the length consisting of hollow medullary cells. If the fleece is not sorted before packing, the hairiness percentage in wool increases.

(8) *Colour :* White wools are preferred by the purchaser, because they can be dyed to the required shade, and in consequence, coloured wools are sold at 10 to 20 per cent less price. All the North Indian types are generally white, whereas the South Indian breeds which produce comparatively coarse wool are generally coloured. In breeds where coloured patches occur on some part of the body, it is imperative that coloured wool should not be allowed to get mixed with the rest of the white fleece. Sheep showing a tendency to grow mixed wool should be eliminated.

(9) Lustre depends upon the power of the fibre to reflect light. To what this quality is due, is not fully understood. Good condition of sheep and their passage through good pastures before shear is usually associated with good lustre, but it is obvious that lustre is a hereditary quality which is well-developed in some English breeds of sheep like Lincoln and Leicester. Indian wools lack in lustre with the exception perhaps of the Gurez breed from Kashmir.

(10) Felting property is a characteristic of wool on account of its scaly surface, fineness, and crimp.

(11) Yield depends finally upon the quantity of nett wool, i.e. after grease, suint, and foreign matter are removed from raw wool. It is generally 60 to 65 per cent of the weight of the raw wool.

(12) Season of production has a profound effect on the quality of wool in India, growth during winter being better than that in autumn, which is often dirty on account of the preceding rains, and is poor in quality for want of enough pasturage during summer.

(13) Moisture in wool is important to the buyer because wool is the most hygroscopic textile fibre. It contains 16 per cent moisture at 60 degrees Fahrenheit. At higher temperatures it gradually loses more and more moisture until the boiling point is reached. It is capable of taking up as much as 30 per cent moisture if stored in a damp warehouse for some time.

Technologically like cotton, the quality of wool, must also be assessed by its spinning behaviour, such that the strength of the resultant yarn reaches the standard strength generally agreed upon for different counts. At present there is no experimental laboratory equipped with spinning machinery for determining the quality of Indian wools. Time is now ripe for such an institution to come into existence.

Utilization of Indian wools

The Indian wools are not at all suited for the worsted industry. The chief avenues of its consumption are, (i) carpet and blanket industry,

(ii) manufacture of tweeds, broad cloth, and overcoatings, and (iii) making of coarse hosiery yarns. As there is a surplus of carpet wool, it is exported. The worsted industry in India depends largely upon imported fine wools, or worsted yarns. The demand for fine woollens far exceeds the production in the country. Accordingly import of large quantities of wool and woollens is made annually both by land and sea routes. Whereas Persia, Central Asia, and Tibet send generally the raw materials by land route, Australia and Europe send both the raw material and the finished goods by the sea route. Before mentioning details of imports, the following information available about the indigenous wools may be given.

The Indian wools are classified by the Indian mills using them as below :

Indian plain wools : There are coarse as well as fine types, the former are used for the manufacture of army blankets, and carpet yarns ; while the latter are used for making overcoating, broad cloth, curtain, blankets, rugs, and weft yarns for serges.

Hill types : They are used for making serge yarns, low grade hosiery, coloured army blankets, and coarse hosiery.

Cross-bred wools : They are utilized in making medium serge warps, worsted warps, and medium hosiery yarns. Short wools of this quality are used in the manufacture of tweeds, broad cloth, overcoatings, etc.

Merino wools : Shorter stapled Merino wools are used for making flannels, overcoatings, and superfine broad cloths. The longer stapled wools of this type are chiefly used for hosiery yarns and fine worsteds. Cross-bred wools and the Merino wools are the best, but the number of sheep of these breeds is indeed small in this country.

The chief markets collecting Indian raw wool are Amritsar, Kalimpong, Shikarpur, and Multan. Bombay and Karachi are the ports used for importing and exporting wool and woollen products. With the partition of the country, Indian Union is left with Amritsar and Kalimpong as collecting centres, and Bombay as the chief port. The largest market for indigenous wool in the East Punjab is Fazilka.

The Indian woollen industry is localized in Kashmir, Amritsar and Dhariwal in the East Punjab, Kanpur and Mirzapur in the United Provinces, and Baroda, Bombay, and Bangalore in the Deccan Peninsula. In 1939, there were 24 woollen mills in India, out of which 16 were situated in British India, and 8 in Indian States. In addition to these mills there were 19 carpet and shawl weaving factories, and 73 hosiery factories, which employed 3,382 and 264 persons respectively. It is further estimated that there were about a lakh of looms engaged at weaving woollen blankets and another 264 hand hosiery machines. During the war the import price of Australian wool rose from 2·66 crores of rupees to Rs. 3·07 crores. Export of wool and carpets from India were valued at Rs. 2·42 crores in 1944, and 3.54 crores of rupees in 1945. There were only four worsted mills in India, but they depended upon supplies of Australian wool. The handloom woollen industry which utilizes most of the indigenous wool is spread throughout the country. Its output consists of coarse blankets which have a very large seasonal demand from poor classes. A section of the industry is devoted to making carpets and *durries* notably at Mirzapur, Amritsar, Srinagar, Bangalore and Ellore. The total capital invested in the industry was between three and four crores in 1939.

Indian imports of woollens comprising knitted apparel, piecegoods, blankets and rugs, worsted yarns, knitting yarns, mechanical cloth, etc. amounted on an average in 1936 to 1939 to 11,100,000 lb., and it is estimated to be about 59 per cent of the total consumption.

As major part of the Indian wool is carpet wool, it is suggested that a guild of carpet manufacturers be formed to avoid dissipation of their efforts in undesirable competition and to move unitedly to improve their products, to utilize the raw material and the wastes of the industry fully, and to organize a world trade for their manufactures. This guild may be in addition to the Federation of Woollen Manufacturers in India, and the Textile Manufacturers' Association, Amritsar. Both the organizations have been recommended to continue by the Panel on Woollen Industry[21]. Similarly, until Indian stock of sheep is improved to make the country self-sufficient for her needs of fine wool, it is suggested that Trans-Himalayan trade in wool be encouraged.

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[21] *Report of the Panel on Woollen Industry* (1946), Department of Industries and Supplies, Government of India.

The Government of India may also offer subsidies to enterprising persons in establishing farms in pasture lands in different sections of the Himalayan Range for introducing Tibetan breeds of sheep.

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THE CENTRAL BOARD OF IRRIGATION MEDAL RULES

THE C.B.I. Medal has been instituted to encourage research relating to and the technique and development of the water resources of India and all devices and matters connected therewith.

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In case no contribution is considered to be of the requisite high standard from among those which enter the competition, the Executive Committee may decide not to make any award in a particular year. (*C.B.I.*)

*For paper and article published during the year 1948, the date has been extended to 30th April, 1949.

WEED-KILLERS

By K. M. THOMAS and A. R. SRINIVASAN

A WEED is described as 'a plant in the wrong place'. The control and possible eradication of weeds has always been a problem for the agriculturist. The losses caused by weeds are manifold. They compete with crops for moisture and plant food. Some, by overgrowing, shade the crop from sunlight, besides preventing free circulation of air amongst the crop plants. Some weeds serve as collateral hosts for insects, fungi, and viruses attacking the crop and thus favour the development of pests and diseases among crops. For one or more of the above-mentioned causes, weeds are harmful to the crop and cause considerable reduction in the yield. Any means that will enable the farmer to reduce the incidence of weed within reasonable limits would tend to increase his profits.

The methods employed for combating weeds can be classified into (1) mechanical, (2) cultural and (3) chemical. Mechanical operations involve a large amount of human and animal labour. The earliest methods employed were the removal of weeds by pulling them out of the soil. A further improvement was the use of implements like hoes and ploughs for digging them out. These are successful in the case of shallow-rooted weeds. By the use of a mould board plough the weeds are buried, but in all these cases there are several limitations. The pernicious weeds do not lend themselves thoroughly to these treatments. With the advancement of scientific research, the technique of destroying weeds was developed on new lines, involving the minimum amount of manual labour. While progress was made on one side in the evolution of new agricultural implements, another line of research indicated the usefulness of chemicals in the control of weeds.

Chemicals as weed-killers

The possibility of killing weeds by using chemicals was first discovered accidentally by a French grape-grower, who when spraying his vines with Boardeaux mixture, found that the leaves of the weed, wild mustard, were blackened wherever the spray had fallen. Shortly after this another French scientist named Bonnet, experimented with various chemicals and found that some plants with broad and rough leaf surfaces were readily killed by certain chemical sprays. A number of substances were tried but as most of them were either corrosive, poisonous or highly inflammable, further research for alternative substances free from these drawbacks went on.

Non-selective weed-killers

Among the various chemicals that were tried, two types of weed-killers were distinguished by their action on the weeds and the crops. Some of the substances were non-selective in action and destroyed all vegetation, whether crop or weed, on which they were applied. These non-selective weedicides could be used only in the absence of a crop such as during a fallow period between two successive crops. A group of substances used for these purposes consisted of various types of mineral oils as gasolene, diesel oil, kerosene, and derivatives of coal-tar, which kill only just those portions of the plant on which they are applied, and do not have any action on the root system of the treated plants. These contact weed-killers were, therefore, found to be useful only in the case of annual weeds, which have shallow root systems and which are usually killed when the tops are destroyed.

Some other non-selective weedicides consisted of chemicals of a poisonous, or corrosive nature, which when sprayed on the plants are found to penetrate into the tissue, get translocated beyond the point of application and finally cause complete death of the plant. These are, substances like sodium arsenite, sodium chlorate, sodium chloride (common salt) and organic compounds containing arsenic. By virtue of their penetrating properties, these formed more effective materials for controlling perennial weeds, which possess underground rootstalks

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and defied all common methods of eradication. Despite this advantage, these chemicals have not become very popular. The arsenical compounds are extremely poisonous to human beings and all animal life. Sodium chlorate is explosive in nature when mixed with organic substances. Common salt, though not dangerous in these respects and is cheap, was effective only when used in large amounts. This however causes harmful after-effects on the soil in which it is applied. Ammonium thiocyanate was free from all these drawbacks and found favour for some time. As this too was rather costly requiring 200 to 300 pounds per acre to be effective, chemicals which were cheaper were sought for.

Selective weed-killer

Weed-killers with caustic action : While the above-mentioned chemicals destroyed all vegetation, whether crops or weeds, some substances were found to have a selective action on certain plants only leaving the others practically uninjured. This phenomenon of killing weeds selectively was first discovered in 1896 by Bonnet, a Frenchman, who found that certain chemical sprays killed broad-leaved plants with exposed growing points, while causing only temporary injury to some other plants such as cereals and grass weeds possessing narrow leaves and well-protected growing points. Of the various chemicals that were tried, sulphuric acid was found to be the best from the standpoint of effective action combined with cheapness. The use of this acid to kill weeds in cereal crops became popular in France and England and the yield in some of the treated areas was reported to have doubled. The acid, however, was corrosive to metal and required spraying machinery lined with lead. Much difficulty was experienced in handling the concentrated acid and spraying the diluted acid. Due to these handicaps, the acid treatment became less popular, and copper compounds were tried as substitutes. Though the weedicidal effect of copper had been discovered as early as 1897, it remained out of favour, as sulphuric acid proved cheaper and more effective. Search for more active copper compounds was made, and it was found that copper chloride was equal in effectiveness to sulphuric acid and was also non-corrosive in nature. Even today copper chloride is being used in some countries as a weedicide in the form of Raphanit, which is a proprietary product containing this chemical. Both sulphuric acid and copper chloride belong to the class of contact weedicides but are not capable of destroying deep rooted, perennial weeds.

Claims were made in France in 1932, that a dyestuff known as Dinitro-ortho-cresol (DNOC) had the property of killing herbaceous weeds, in crops of onion, flax and cereals. This claim was later found to be well-founded and the dyestuff became a popular weed-killer in France and America. Many proprietary products in the form of pastes, dusts, emulsions, etc. were put on the market, and some of these are available today. Extar Sandoz, Denoc, Denocate and Sinox are some weed-killers of this class. Most of the common annual weeds are controlled by spraying the solutions of substances containing five to eight pounds in 100 gallons of water over an acre. But these substances have also proved to be only contact herbicides which are not effective in the case of perennial weeds, with underground root-stalks.

Hormone weed-killers : A new approach to differential weed control arose out of a war-time discovery of a new class of weed-killers, the hormone weed-killers. Hormones are substances which are capable of inducing growth in plants. Many of these substances have been in use in horticulture for various purposes as promoting root development in stem cuttings, stimulation of the development of seedless fruit, prevention of premature dropping of fruit, etc. Recent researches in England and the United States of America during the Second World War showed that some substances of this kind killed treated plants by inducing over-growth and malformations when slight overdoses were applied. It was also found that these substances had no effect on established plants of cereal crops and grass weeds. The importance of this discovery was at once realized and a search for more active substances of this type went on. As a result, two most active substances were selected from among several hundred substances tested for their weedicidal action. These substances were soon incorporated into proprietary preparations by chemical firms, and are available under the names of Phenoxyl, Methoxone, Agroxone, Bar weed 44, etc.

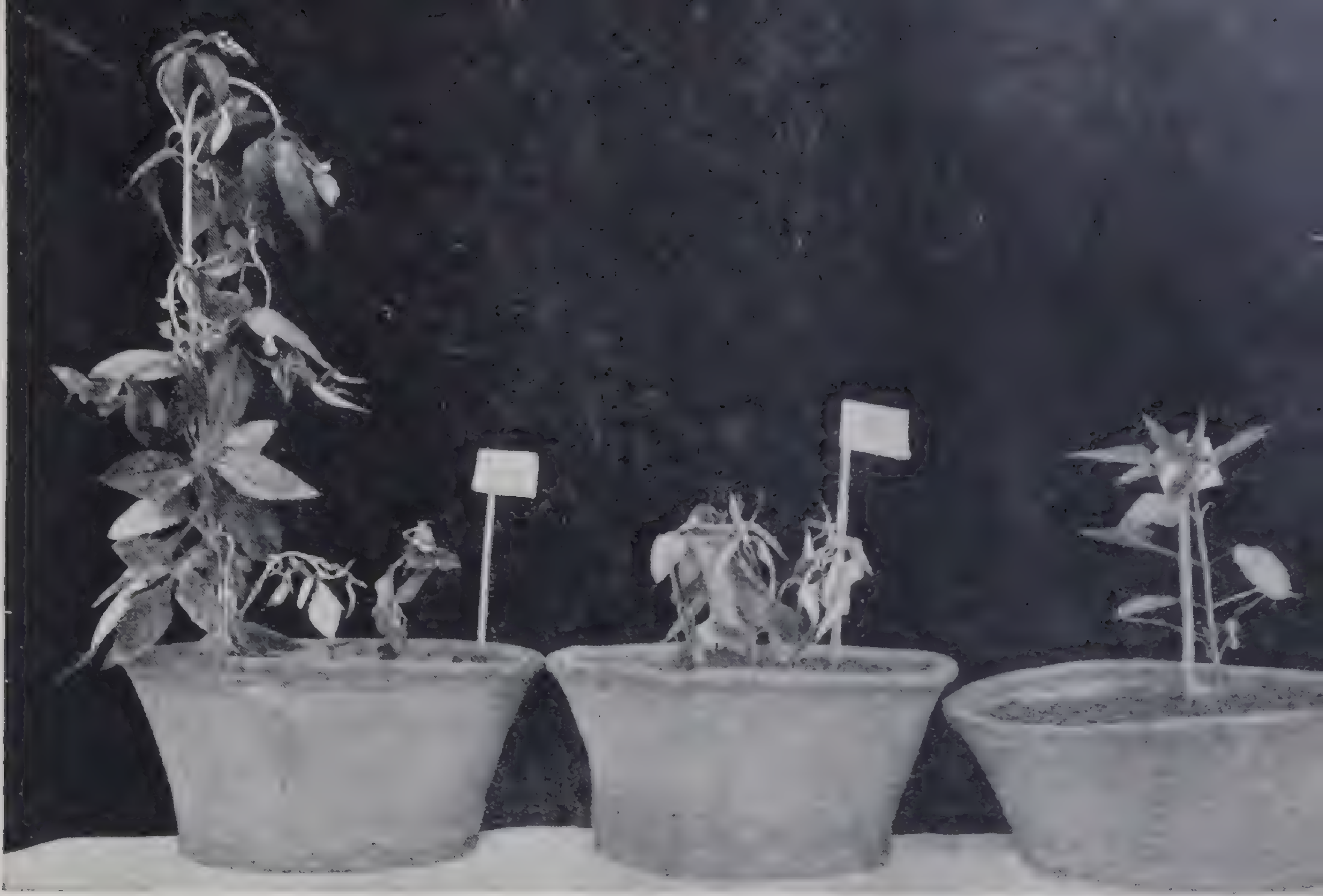
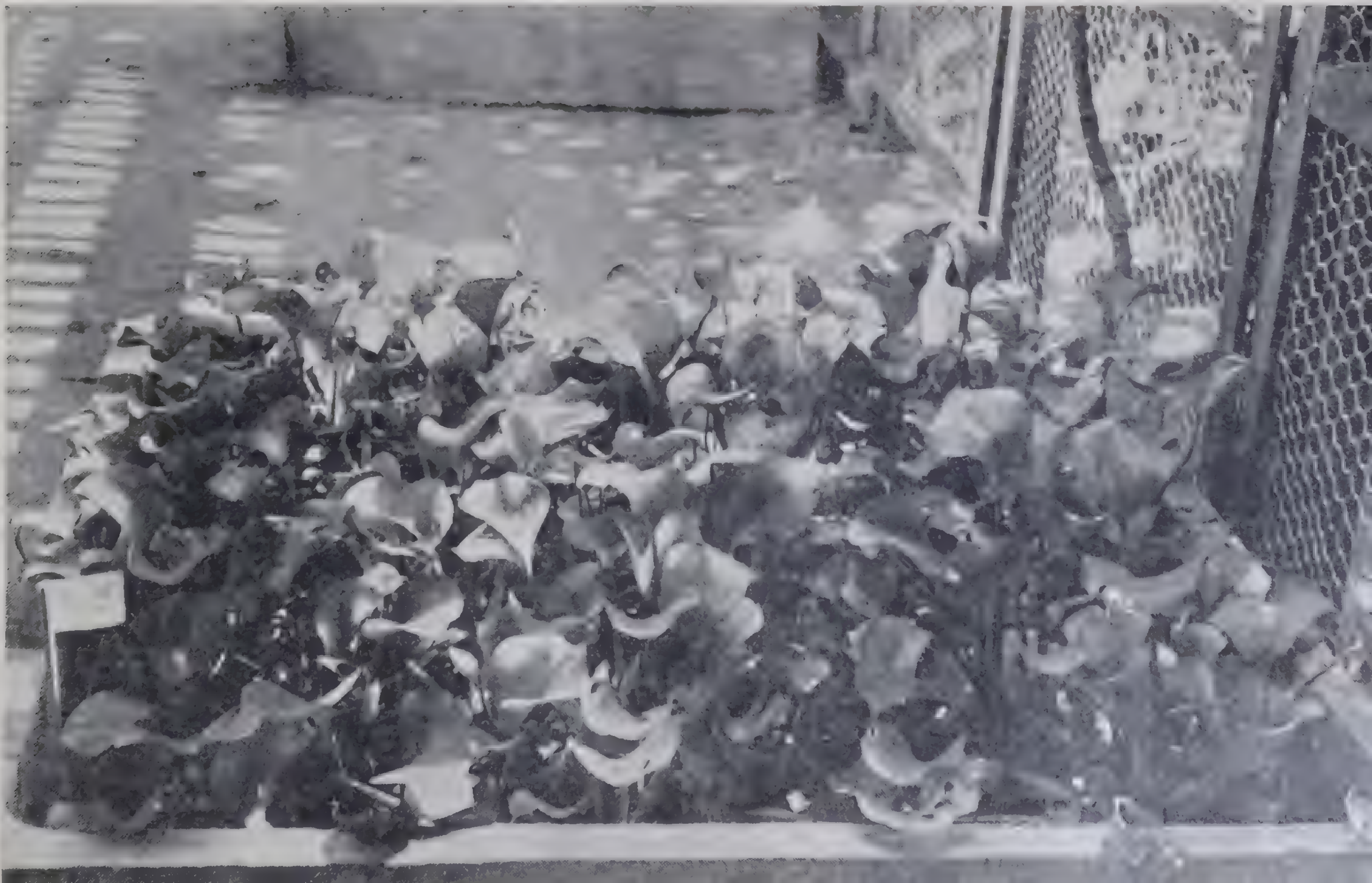


FIG. 1. *Bidens pilosa* (spanish needle) sprayed with 0·2 per cent MCPA. Left: Plants just in flower Middle: Plants before flowering. Right: Plants untreated.

FIG. 2. Water-hyacinth untreated.



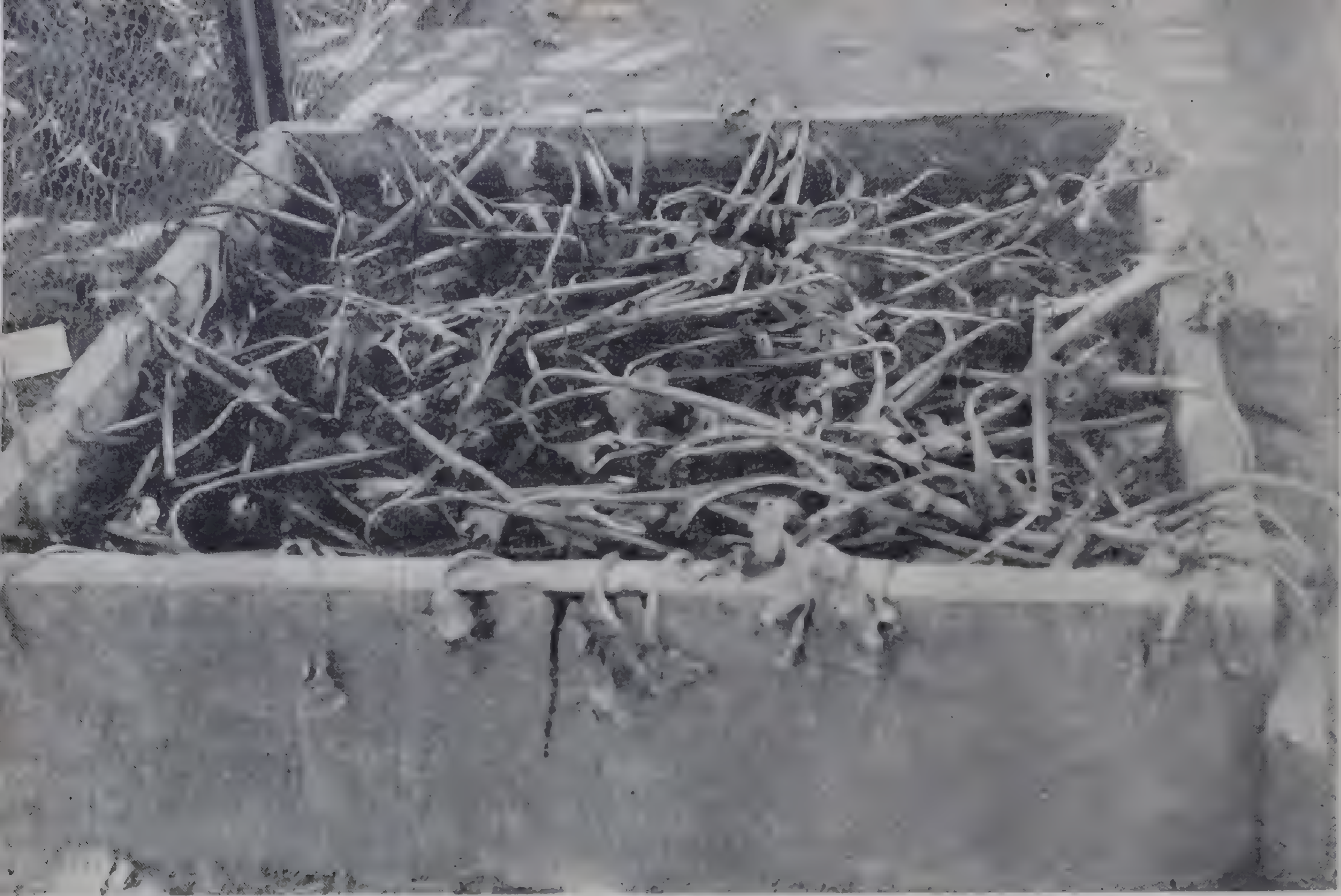
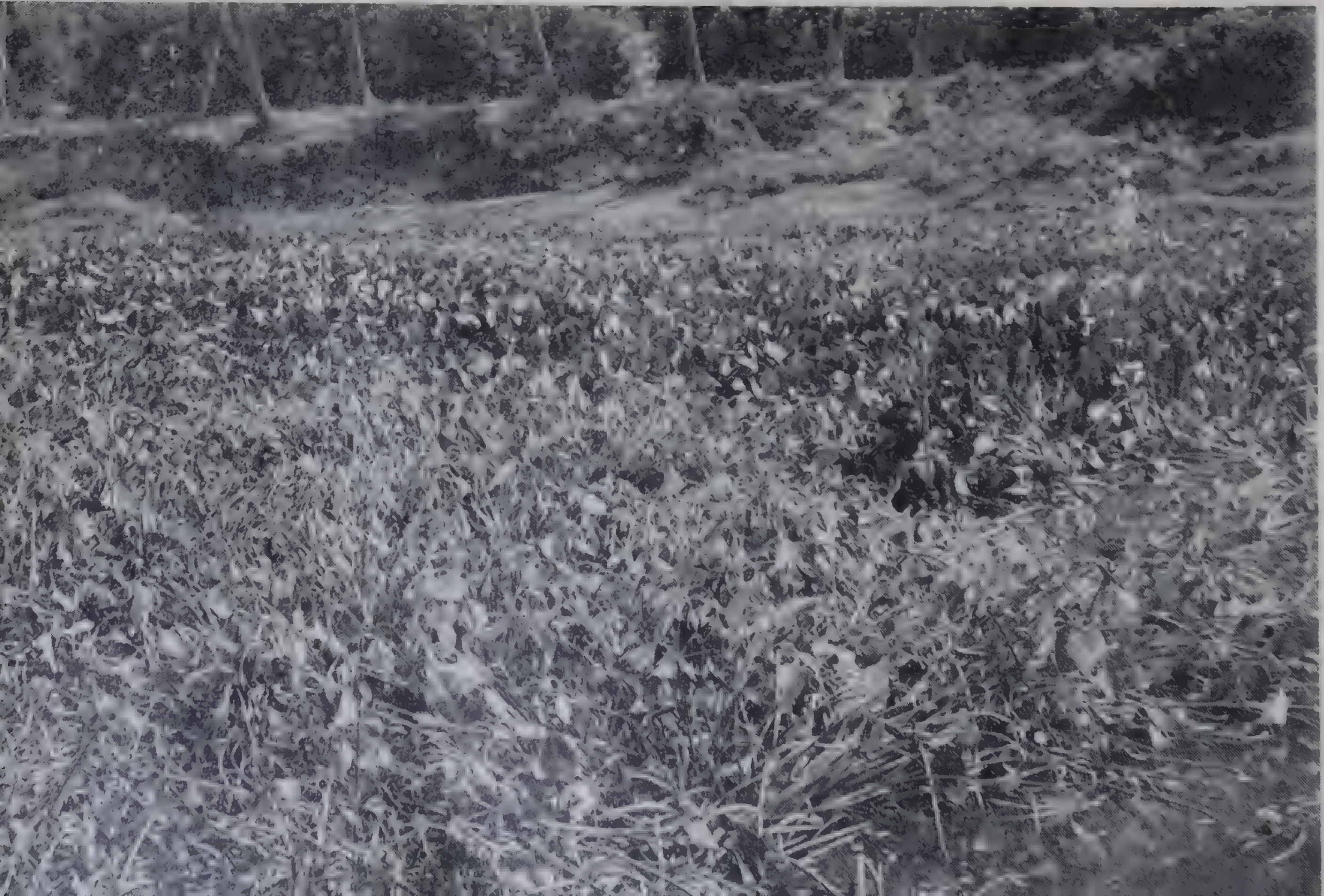


FIG. 3. Water-hyacinth 15 days after spraying with 0·05 per cent MCPA.

FIG. 4. Water-hyacinth in Noyyal river bed I—seven days after spraying with 0·05 per cent MCPA.



Special features of hormone weed-killers

The hormone weed-killers are not merely contact herbicides like the other selective weed-killers, but have a more permanent action on the weeds affecting their root systems also. They are absolutely non-corrosive and non-poisonous to men and animals. The capacity to penetrate and get translocated in the tissues of plant makes them quite desirable for use in the control of perennial weeds. Tests conducted in England and America have shown that many perennial and deep-rooted annual weeds, which have resisted all other weed-killers (except the hazardous arsenic compounds), were easily controlled by these. Experiments conducted by the Government Mycologist, Coimbatore, have shown that these are the only substances capable of destroying effectively undesirable floating aquatic weeds as water-hyacinth, *pistia*, etc. Another advantage with these hormone weed-killers is that small concentrations of the weed-killers, as 2,000 to 4,000 parts per million are enough to kill the weeds. This dose is less than half the minimum dosage used for any other known weed-killer. These substances are now widely used in England and America to eradicate weeds in lawns, golf greens and cereal crops.

When and how to use weed-killers

All the chemical weed-killers are most effective when applied on the young weeds which are actively growing. This is particularly true of the hormone weed-killers, which are far less effective when applied on mature plants. The destructive action of the weed-killers proceeds more rapidly in direct sunlight than in shade. Rains immediately following the treatments with these chemicals, wash them off the leaves of the weeds, and thus considerably reduce the effectiveness of the treatment. Hence it is necessary that the sprayings be carried out during a dry spell of weather and if there is a rain within 24 hours after applications, it is advisable to give a second treatment.

Control of weeds by using chemical weed-killers is a new venture in Indian agriculture, and is naturally full of risks that are inevitable in any innovation. The risk in this case lies in the indiscriminate use of these substances. As most of the weed-killers are lethal to non-cereal crops, careless use may result in total loss of crops. Information on the effect of these chemicals on various crops and weeds should be gathered before recommending them for general use. Moreover, one particular weed-killer alone cannot be used as a remedy against all weeds. Sometimes combinations of more than one weed-killer may be necessary to tackle a mixed formation of weeds. Studies on these lines are in progress at Coimbatore and the results obtained so far are summarized below. In these trials, a form of MCPA was mainly used, and some tests were also conducted on the merits of a Dinitro-cresol type of weed-killer.

Weeds classified

On the basis of their sensitivity to the weed-killer, the different weeds may roughly be grouped into three classes, viz. the susceptible, the intermediate and the resistant weeds.

Susceptible weeds :

1. *Eichornia crassipes* Solmes (*English :* Water-hyacinth ; *Tamil :* Neitha-marai ; *Malayalam :* Kulavalai.)

This is a noxious aquatic weed causing a lot of nuisance in water sources, irrigation canals and navigable rivers. The weed is susceptible to MCPA at all stages of development. At Coimbatore it was killed in twenty days with a strength of 0·05 per cent of the active hormone.* In the humid and cool climate at Ootacamund, 0·1 per cent was effective in the same period.

2. *Pistia stratiotes* L. (*Bengali :* Takapana ; *Gujerati :* Jalakumbi ; *Hindi :* Jalkumbi, Takapani ; *Tamil :* Akasathamarai ; *Malayalam :* Antharathamara).

This is a quickly reproducing aquatic weed found especially in the districts of Malabar, Tanjore, Tinnevelly, etc. Its roots have been reported to be favourable breeding places for mosquitoes carrying filarial parasites. A strength of 0·2 per cent MCPA effectively kills weeds in 10 to 12 days.

3. *Bidens pilosa* L. (*English :* Spanish needle ; *Gujerati :* Phutium).

A troublesome weed in coffee and tea plantations which is killed in a week by spray application. Best effect is noted when the plants are in the seedling stage.

4. *Chrozophora rottlerii* Klot. (*English :* Turnsole ; *Gujerati :* Kalukharad ; *Hindi :*

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* Unless specified, the rate of spray fluid in all cases is 100 gallons per acre.

Shadevi, Sanballi, Subali; *Marathi :* Suravartha ; *Telugu :* Gurugu).

This is a hardy weed in tank bunds and black cotton tracts of the Madras province. It is killed by MCPA of 0·2 per cent strength.

5. *Ruellia prostrata* Poir. (*Gujerati :* Kalighavani ; *Malayalam :* Upudali ; *Tamil :* Pottakanchi).

This is a diffuse undershrub killed by 0·2 per cent MCPA in ten days.

6. *Corchorus olitorious* L. (*Bengali :* Banpat, Koshta ; *English :* Jew's mallow, jute; *Gujerati :* Chhunchho ; *Hindi :* Koshta, Pata ; *Tamil :* Perumpunnakku poondu ; *Telugu :* Parinta).

The plant is the commercial jute growing wild as a weed in Madras province. A 0·2 per cent MCPA kills it in ten days. Plants are best affected when they are quite young.

7. *Corchorus trilocularis* L. (*Gujerati :* Kadvichhunchhdi ; *Hindi :* Kadukosta, Kadvapat ; *Tamil :* Punnakkupoondu).

This is a weed in black cotton soils on heavy loams of irrigated lands. The weed is killed by 0·2 per cent MCPA in one week.

8. *Argemone mexicana* L. (*English :* Prickly poppy, Mexican poppy ; *Hindi :* Bharband, Biladathura, Bhrahmadundi, Brahmi ; *Malayalam :* Brahmadandi ; *Tamil :* Brahmadandu, Kurukku ; *Telegu :* Brahmadandi).

It is the most widespread prickly annual weed in light soils which is completely controlled by 0·2 per cent MCPA in one week.

9. *Amaranthus viridis* L. (*English :* Pig weed ; *Gujarati :* Dhimdo ; *Marathi :* Lhanamat ; *Tamil :* Kuppaikeerai).

This is a gregarious weed and is killed by 0·2 per cent MCPA within ten days.

10. *Gomphrena decumbens* Jacq. (*Tamil :* Neer vadamalli).

The weed is a native of Central America recently introduced in India and is vigorously spreading in all parts of the country. A strength of 0·2 per cent MCPA, sprayed at the rate of 150 to 200 gallons per acre, effectively kills the weed in ten to fifteen days.

11. *Lagasca mollis* Cav.

This is another introduced weed and at present one of the most troublesome weeds in South India interfering with the growth of grasses in pastures. It is also a common weed in irrigated fields. The weed easily succumbs to a spray of 0·2 per cent MCPA, within ten days.

12. *Cyantois axillaris* R. and S. (*Hindi :* Baghanulla, Soltraj ; *Tamil :* Nirpulli; *Telugu :* Golagandi).

This is a fleshy annual weed in garden lands and in irrigated areas. Plants are killed within one week after application of 0·2 per cent MCPA, if they are in the 4 to 5-leaved stages.

13. *Striga lutea* Lour. *Striga densiflora* Benth. (*English :* Witchweed ; *Gujerati :* Agiyo : *Hindi :* Agia ; *Marathi :* Laghukurandika ; *Sanskrit :* Agnivriksha ; *Tamil :* Sudumalli).

This is a common parasite on millets like *sorghum, bajra, ragi* (*Eleusine coracana*) and *tenai* (*Setaria italica*). When 0·2 per cent MCPA is sprayed on young shoots before flowering the weeds are killed in two weeks.

14. *Striga euphrasioides* Benth. (Vernaculars the same as for the other two species of *Striga*).

This is a common parasite on paddy and sugarcane and is killed by 0·2 per cent MCPA in two weeks.

15. *Orobanche cernua* Loeff. var. *desertorum* Beck. (*English :* Broom rape : *Hindi :* Tokra ; *Tamil :* Pugaiyilai kalan).

This is a very noxious parasite on tobacco, tomato, brinjal, etc. which causes reduction in the yield of tobacco. Spraying 0·2 per cent MCPA proves injurious to the crop on which the weeds grow. So the weeds can only be tackled by the application of the weed-killer on the parasitic shoot by swabbing or painting over it without allowing the chemical to get into contact with the leaves of the crop plant.

16. *Spergula arvensis* L. (*English :* Spurry).

This weed is a native of Europe, which has been introduced into our country. This is a noxious weed which has assumed threatening proportions in some tracts of Nilgiris and smothers the crop in the fields in which it occurs. It is killed by 0·2 per cent MCPA in two weeks.

17. *Hydrocotyle rotundifolia* Roxb.

This is another common weed of the hills, having a runner stem, which by its vigorous growth smothers the grass in the lawns and is thus a nuisance in lawns and golf greens. This is completely killed by even 0·1 per cent MCPA.

18. *Hydrocotyle asiatica* L. (*English :* Asiatic pennywort; *Hindi :* Brahmamanduki ; Khulakhudi; *Malayalam :* Kodagam; *Tamil :* Vallarai; *Telugu :* Bokkudu).

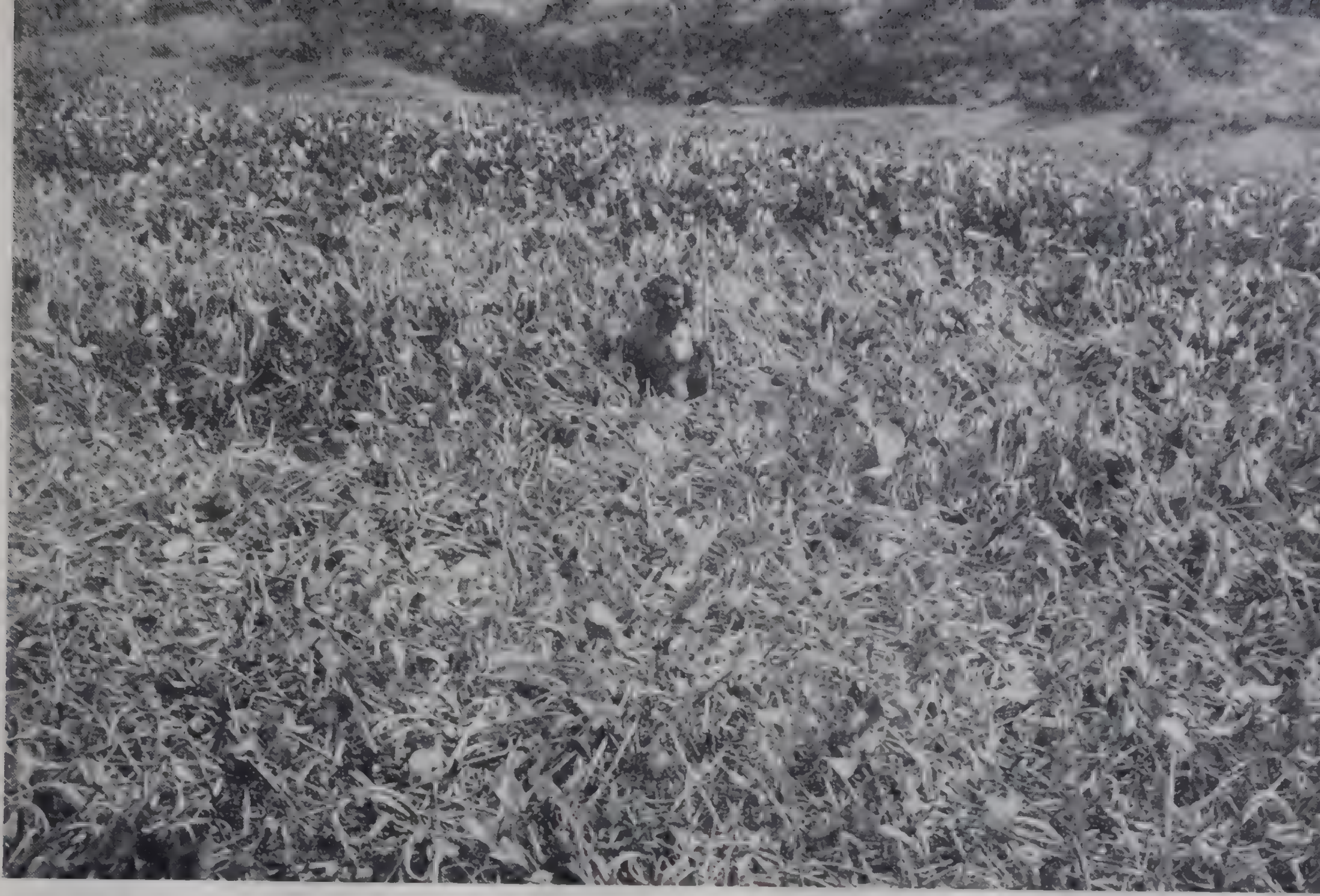
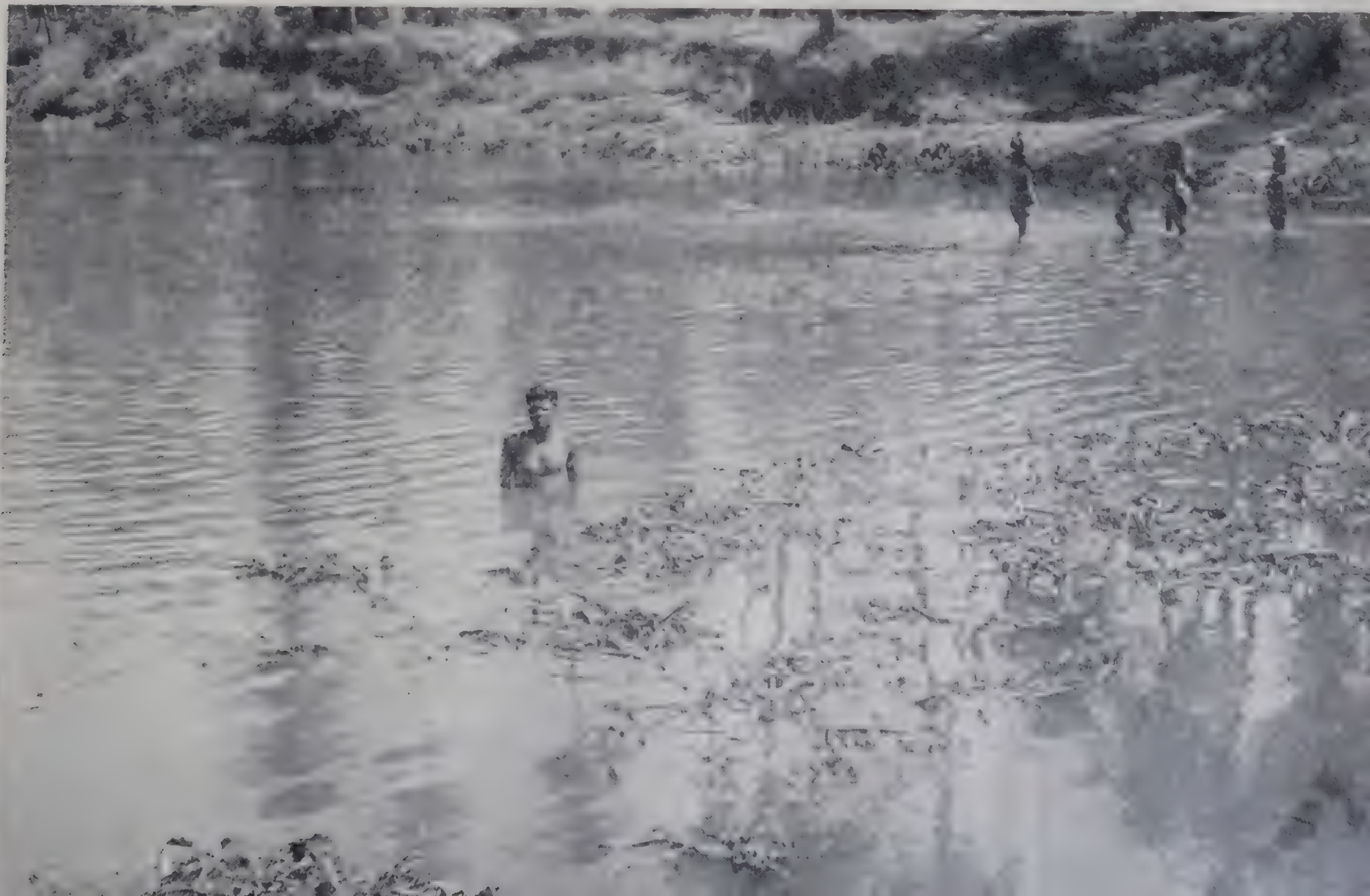


FIG. 5. Water-hyacinth in Noyyal river bed II—14 days after spraying with 0·05 per cent MCPA

FIG. 6. Water-hyacinth in Noyyal river bed III—20 days after spraying with 0·05 per cent MCP



This is a common weed in damp soils, and is known to be of medicinal importance. This is killed by 0·2 per cent MCPA in a week.

19. *Oxalis corniculata* L. (*English :* Indian Sorrel ; *Hindi :* Chalmori, Amrul, Surchi ; *Tamil :* Puliyarai ; *Telugu :* Pulichinta, Ambotikura).

This is a common weed of coffee and tea plantations, perennating through underground bulbs. The tops of the weeds are killed by 0·1 per cent MCPA in a week.

20. *Datura* sp. (*Bengali :* Dhutura ; *Hindi* Dhatura ; *Malayalam :* Ummathe ; *English :* Thorn apple ; *Tamil :* Umathai ; *Telugu :* Ummatti).

These are common poisonous weeds of which three forms *D. fastuosa*, *D. fastuosa* var. *alba* and *D. stramonium* are found at Coimbatore. All the three species succumb to the effect of 0·2 per cent MCPA within one week after application.

Other weeds easily killed by 0·2 per cent MCPA are :

21. *Physalis minima* L. (*Bengali :* Bantepariya ; *Hindi :* Chirpoti, Dhanmori ; *Tamil :* Takkali ; *Telugu :* Kupanti).

22. *Eclipta alba* L. (*Bengali :* Keshori ; *Gujerati :* Bhangra, Dodhak ; *Hindi :* Babri, Bangra ; *Sanskrit :* Ajagara, Mahabringa ; *Tamil :* Karisaranganni ; *Telugu :* Guntakalagra).

23. *Achyranthes aspera* L. (*Bengali :* Apang ; *Hindi :* Chirchira ; *Tamil :* Nayuruvi).

24. *Tridax procumbens* L. (*Tamil :* Mukkuthi poondu).

Intermediate:

1. *Malvastrum coromandelianum* Garcke. This is a shrubby weed, which is a native of America and introduced into India. It is now found in all provinces of our country. It is killed by 0·2 per cent MCPA only when applied at the 2-leaved stage of the weed. If the weeds are slightly older complete killing is not accomplished even with a strength of 0·3 per cent MCPA.

2. *Gynandropsis pentaphylla* De. (*Bengali :* Hurhuriya ; *Hindi :* Hulhul, Hurhur ; Safedhulhul ; *Malayalam :* Taivela ; *Sanskrit :* Tungi ; *Tamil :* Naivelai ; *Telugu :* Vaminta).

This is a weed of cultivated lands. It is killed in early stages (i.e. 3 to 4-leaved stage, by 0·2 per cent MCPA but is resistant to the chemical during later stages.

3. *Cyperus rotundus* L. (*Bengali :* Mutha ; *Hindi :* Motha, Mutha ; *Sanskrit :* Bhadrakshi, Granthi ; *Tamil :* Korai ; *Telugu :* Gantala).

This is a perennial weed which propagates vegetatively by its tuber which lies deep seated in the soil and has defied all means of eradication. Spraying 0·2 to 0·3 per cent MCPA on young shoots before flowering kills the tops and the rhizomes from which the tops have developed. As further growth occurs from rhizomes which had not produced tops, more than one application is necessary. The investigation on the number of applications necessary for complete eradication is in progress.

4. *Alternanthera echinata* (*Marathi :* Kanchari ; *Tamil :* Kantinvullu).

It is a thorny weed infesting sandy or gravelly soils and clayey basis. A strength of 0·3 to 0·4 per cent is necessary to kill this weed and complete death occurs in fifteen days.

Resistant weeds :

1. *Portulaca quadrifida* L. (*Bengali :* Chotaluniya ; *Hindi :* Loniya, Chottaloniya ; *Tamil :* Sirupasavaikirai ; *Telugu :* Kura, Payalku).

This weed with small fleshy leaves is resistant at all stages of development to MCPA up to a strength of 0·4 per cent. But this is easily killed by another selective weed-killer of the Dinitro-cresol type, viz. Extar Sandoz at 2 per cent strength.

Other weeds which were resistant to both MCPA and Extar Sandoz are :

2. *Portulaca olevacea* L. (*Bengali :* Barraloniya; *English :* Common purslane; *Hindi :* Barraluniya, Kulfa, Munya; *Malayalam :* Korichura; *Tamil :* Paruppukeerai ; *Telugu :* Pappukura).

3. *Borreira hispida* K. Schum. (*Hindi :* Madhanaghanti ; *Tamil :* Nathaichur ; *Telugu :* Madanagrandi).

4. *Croton sparciflorus* Mor. (*Tamil :* Naimilagai).

5. *Acalypha indica* L. (*Bengali :* Muktajari ; *Gujerati :* Vanchhikant; *Hindi :* Khokali, Kuppi; *Tamil :* Kuppaimeni ; *Telugu :* Kuppaichettu).

6. *Trianthema portulacastrum* L. (*Bengali :* Sabuni ; *English :* Horse purslane ; *Hindi :* Salsabuni, Vishakhapra ; *Tamil :* Saranai ; *Telugu :* Yerrugaligeru).

7. *Trianthema decandra* L. (*Bengali :* Gadabuni ; *Hindi :* Gadabani ; *Tamil :* Vellaisaranai ; *Telugu :* Tellagalijeru).

8. *Trianthema triquetra* Rottl. (*Tamil :* Sirusaranai).

9. *Phyllanthus niruri* L. (*Hindi :* Bhuinanvalah; *Tamil :* Keelanelli).

10. *Phyllanthus madraspatensis* L. (*Tamil :* Melanelli).

11. *Cynodon dactylon* Pers. (*Bengali :* Durba ; *Hindi :* Hariali ; *English :* Creeping *cynodon ; Tamil :* Arugampul).

All true grasses are resistant to both Extar Sandoz and MCPA. In the case of *Trianthema portulacastrum* however it was found that the weed is killed by 1 : 1 mixture of 0·2 per cent MCPA and 2 per cent Extar Sandoz.

Effect on crops

A number of crops were tested for their susceptibility to MCPA and it was found that with the exception of cereal crops such as rice (*Oryza sativa*), *sorghum* (*Sorghum vulgare*), *bajra* (*Pennisetum typhoideum*) and maize (*Zea mays*), all others were found unaffected by MCPA up to a strength of 0·4 per cent. Potato plants which were 6 weeks old appeared to be resistant to 0·2 per cent MCPA. All other non-cereal crops tested including five oilseed plants, six pulses, seven vegetables, cotton and tobacco were found to be extremely sensitive to 0·2 per cent MCPA. In the case of groundnuts (*Arachis hypogaea*) seedlings were affected and overgrowth of the hypocotyl became evident but the plants recovered. When young plants were sprayed they recovered after a temporary setback in growth. Some of the treated plants were later observed to produce flowers and pods but their growth was far slower than the untreated control plants.

GANDHIJI'S CONCERN FOR FARMER'S WELFARE

LAYING a wreath today at the *Samadhi* of Mahatma Gandhi at Rajghat, Mr. Norris C. Dodd, Director-General of the F.A.O. of the United Nations, said :

'I deem it a great privilege and an honour to be able to lay this wreath at the *Samadhi* of Mahatma Gandhi, the Father of the Indian Nation and the greatest apostle of peace and non-violence that the world has known for several centuries. Though—alas—he is not with us today, his life and selfless struggle for others will be a shining example not only for the present generation but for generations to come.

'As a farmer and as one connected with various Farmers' Organizations for several decades, I am particularly happy to offer this small token of my esteem and respect. Gandhiji's crusade for the conservation of land and better conditions of living for farmers has great significance for all of us, especially in view of the present food shortage and the fact that two-thirds of the world's populations are farmers. So long as History is written, I have no doubt, his name will ever be emblazoned in letters of gold, and men in all parts of the world will remember him with veneration'. (*P.I.B.*)

PRACTICAL RESULTS OF SOME OF THE CULTURAL OPERATIONS IN *SORGHUM*[*]

By M. M. JAMKHINDIKAR

JOWAR is one of the most important crops in this country. It is grown practically in all the provinces, but the main areas of production are in the Bombay Presidency, the Madras Presidency, Hyderabad State, the Central Provinces and Berar and the United Provinces. It occupies an area of 31,198,000 acres in the Indian Union, and 7,555,000 acres in the Hyderabad State.

Ecological studies

This crop grows in those areas where the annual rainfall is not more than 40 inches. Its water requirement is less than that of maize. *Jowar* is a heavy feeder and is considered to impoverish the soil but the depressing effect is said to be temporary, and most pronounced on the succeeding crop, more on cereals than legumes. It is grown mostly as a *kharif* crop but in Western India and Madras it is also grown as a *rabi* crop. The average temperature during the growing season ranges from 80 to 90° F. but many varieties can stand a temperature of 60° F. as a lower and 105° F. as an upper limit.

Soils

It is generally grown on all kinds of soils but does not thrive in sandy soils and does better in heavier types. Its cultivation is largely associated with the black cotton soils.

Depth of sowing

Farm trials at Hagari, showed that sowing the seed at a depth of 2 inches gave a higher yield than deeper sowing but trials at several other Dry Farming Stations, have shown that 2½ to 3½ inches is the optimum depth for germination and early development of the *sorghum* plant. Deep sowing is not desirable.

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Grading the seeds

In the Bombay Presidency seed grading has become a permanent feature in the East Deccan and with the help of non-official agencies 440,000 and 330,000 lb. of *jowar* seeds were graded during the years 1931-32 and 1932-33 respectively. The increased yield due to seed grading was estimated to be 10 to 15 per cent. But at Guntur and Coimbatore grading did not give consistent results. At Guntur a seed rate of 9 lb. per acre was found to be the best while in trials at Sirguppa a seed rate of 3 lb. per acre gave the highest yield.

Spacing experiments

When sown in lines the distance between the rows varies from 13 inches to 2 feet, and the distance between the plants is about 12 inches in each row.

Madras spacing trials : In spacing trials at Hagari, yield increased steadily from 250 to 433 lb. per acre as spacing between rows was widened from 13½ to 27 inches. At the same place in another trial, spacing of 27 inches and 15 inches gave a higher yield of fodder and 27 inches spacing a bolder grain than the controls. At Nandyal, spacings of 10½ to 24 inches made little difference in yield.

Bombay spacing trials : At Dharwar, and other centres in Bombay an 18 in. spacing was found better than narrower spacings.

Hyderabad spacing trials : Spacing experiments with a local red *kharif* variety showed that with rows 18 inches apart and spacing of plants within rows at 3, 6, 9, 18, and 12 inches, the 12 and 18 inches spacings were significantly superior to the 3 inches spacings. The yield of grain increased significantly as the spacing between plants increased ; but reverse was the case with the straw yields. A similar experiment with *rabi jowar* showed that 12 inches spacing was better in yield of grain than the control 6 inches spacing, which was in turn better than other spacings but not to the extent of statistical significance. In case of straw yields, 6 and 9 inches spacings were better but here again not significantly. In another experiment where plants were spaced both ways at 12, 15, 18, 21 and 24 inches, similar results with *kharif jowar* inter-plant spacings were obtained; except that in this case the differences between fodder yields were also not significant. In another experiment the row-to-row distance was kept constant at 18 inches and different plant to plant spacings adopted were 6, 9, 12 and 18 inches. The grain yields were not significant but the following were observed regarding straw yields :

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[*] This article presents a summary of all the cultural operations except manuring and irrigation.

(1) The trend of yield was the reverse of that of grain, the 6 inches spacings giving the highest yield which falls down with increased spacings.

(2) Except the 18 inches spacings, the differences in the straw yields between 6, 9 and 12 inches spacings were not marked.

(3) The yield in 6, 9 and 12 inches spacings were significantly superior to that of 18 inches spacings.

Preparatory tillage

Of the five treatments used in the Bijapur Dry Farming Station for the preparation of land, deep ploughings in alternate years were better than the remaining two treatments of harrowing and discing. The grain yields by this form of tillage were 18 to 22 per cent greater than those from harrowing. The straw yields were also 12 to 29 per cent higher than those obtained by harrowing. But the differences were not statistically significant due to high standard errors.

At Manjri Dry Farming Station, the value of deep ploughing to a depth of 7 to 8 inches was compared with shallow cultivation with a blade harrow or with a tine harrow which penetrates to a depth of only 3 to 5 inches, during a period of four years from 1929-30 to 1932-33. The average yield of *sorghum* grain by ploughing over blade harrowing was nearly 60 per cent and that by the tine harrowing was 47 per cent. But the special condition of the virgin nature of the land must be borne in mind in interpreting the results. Deep annual cultivation or the use of iron ploughs as distinct from the country plough made little differences in yields at Hagari, Nandyal and Guntur. It has been observed that deep ploughing when occasionally done is beneficial on clayey types of soils found in South India. Ploughing every year was harmful in some cases, while shallow eroded type of soil was adversely affected by ploughing.

Ridge cultivation

In 1921-22 it was observed that repeated shallow hoeings to the land during droughts in the Sholapur District of the Bombay Presidency resulted in a 25 per cent higher yield of crop while an increase in yield to the extent of 55 to 60 per cent was obtained in three successive years by the adoption of ridge cultivation in black soils of Gujerat suffering from waterlogging. Later on it was also observed that ridging and intercultivation increased the yield by 23 per cent, while manuring along with ridging raises the outturn by 24 to 31 per cent in the same soils.

Bunding

Bunding gave an average increase of 55 lb. per acre in yield in several trials conducted at Hagari, Guntur and Coimbatore. At Hagari 18 inches bunds proved superior to shallower bunds. At Raichur, in Hyderabad, it was observed that ploughed and bunded plots had a root system which was 37 per cent greater than in no manure-plots. Bunding the fields accompanied by ploughing was found to be of advantage both from the point of view of increased yields and extra profits. The root system of *jowar* plant examined at Hagari was 37 per cent greater in bulk and 111 per cent better in lateral spread in the ploughed and bunded plots than in the control. The bunded plots of the *sorghum* grain yielded nearly 25 per cent more than the control but the differences were not significant.

In 1940-41 in Madras, it was observed that there was a significant increase of 115 per cent as a result of bunding but in straw yield there was an increase of only 3 per cent which was not significant. In bunded plots both the lateral spread and the vertical penetration of the roots were greater and consequently, the soil-volume of root-spread was also greater. The ratio of the soil-volume of root-spread to plant height was also higher in the bunded plots.

At Manjri Dry Farming Station there was an average increase of 7·8 per cent in yield in the bunded plots of *jowar* over the unbunded ones. In the year of heaviest rainfall there was a slight decrease in yield of *jowar* grain in bunded plots, but in other years the increase varied from 5 to 28 per cent according to the amount of rainfall and its distribution. At Hagari the average yield of *sorghum* grain from unbunded plots amounted to 285 lb. per acre, while bunding resulted in increasing the yield to 311 lb. per acre. The average increase was thus 9 per cent. The results were positive in seven out of nine years. The two years in which bunding resulted in slightly decreased yields were years of good rainfall.

Scooping, mulching and interculture

At Raichur Dry Farming Station, scooping experiments with *rabi jowar* by the improvised Bullock Hoe gave a 8·3 per cent higher yield but the effects were not statistically significant.

At the Manjri Dry Farming Station, experiments conducted for a period of over five years showed, that interculturing to a depth of 2 inches on non-bunded plots gave on an average nearly 10 per cent increase in grain yield as compared to unstirred plots.

At Sholapur by mulching the average yield from the medium deep soil and light soil showed an increase of 28·9 and 22·7 per cent respectively. Yields of straw were however not much affected by mulching.

At Bijapur, on deep black soil, mulching gave increased yield of *sorghum* grain in four out of six years; but in two years there was some decrease. In limy soil, mulching showed advantage only in one out of six years. The differences were statistically significant. It seems from the results obtained that the effect of mulching may differ according to soil type and also according to seasons.

At Hagari, the grain yield of all intercultured plots taken together showed an increase of 17 per cent over the plots receiving no interculturing and weeding. The average increase by different interculturings varied from 13 to 28 per cent. Mere removal of weeds without interculturing increased the yield by about 11 per cent.

Residual tillage effects

At Raichur, an attempt was made to find out if the effect of different tillage methods, adopted for the previous cotton crop, would in any way be reflected upon the *jowar* of the succeeding year. The different treatments of the previous year were (i) deep ploughing, (ii) tine-tooth cultivation and (iii) blade harrowing. The basal treatment for the soil for that year was blade harrowing only. The yields of both grain and straw were the highest from deep ploughing, followed by the tine-tooth cultivation and the blade harrowing.

At Sholapur an experiment was carried out to test the effects of varying intensity of tillage before sowing and after sowing. The experiment though not significant as regards grain yield showed that greater number of harrowings and interculturings gave higher yields as compared to one harrowing and one interculturing. As regards straw, the experiment was significant and four harrowings and four interculturings gave nearly double the yield as compared to one harrowing and one interculturing.

Rotational experiments

At Bijapur Dry Farming Station, the performance of *jowar* after cotton was compared with that of *jowar* after *jowar* on two types of soils. On limy soil in the case of *jowar* after cotton, the yield of grain and straw was greater than the control by 53 per cent and 38 per cent respectively. On deep black soil, no increase in yield was observed and the differences were not significant. In Hyderabad Dry Farming Scheme an experiment was conducted involving continuous cropping and cropping of plots in alternate years.

The points in favour of cropping in alternate years were:

(i) The alternate year-cropped plots showed a distinct superiority in general vigour and growth of plants and gave better-sized earheads.

(ii) The crop in the continuously cropped plot was sickly and showed signs of yellowing.

(iii) The experiment was significant and gave an increase of 44 per cent of grain and 41 per cent of straw in favour of alternate-year cropping.

In another trial at Bijapur, *sorghum* grown in rotation with cotton on deep black soil gave distinctly higher yields in four out of five years.

Fallowing experiments

At Manjri, it has been observed that by fallowing the average increase in grain amounted to 37 per cent and that in straw to 58 per cent.

At Sholapur, in three out of six years, fallowing gave increased yields but the increase was even less than those obtained at Manjri. In the remaining three years fallowing gave lower yields than control. In three years, the soil showed a distinct hardening of the surface layer which interfered with proper development of the root system, and the early establishment of the *sorghum* plants. In the light shallow soils, fallowing had a depressing effect on *sorghum* yields in majority of the seasons.

At Bijapur, the results on deep black soil showed an average increase of 67 per cent in grain and 64 per cent in straw. The yields of grain were significantly higher in three years and those of straw in four years. The reduced expenditure in a fallow year and the 67 per cent higher yield after fallow together could compensate largely for the loss of a year's crop in alternate years. On the limy soil the average increase in grain yield of *sorghum* by fallowing was 54 per cent during the six years. The average yield per acre by fallowing was 359 lb. of grain and 727 lb. of straw as against 233 lb. of grain and 569 lb. of straw by continuous cropping. The increase in straw was 27 per cent. The increase of grain and straw was statistically significant only in one out of six years. At Raichur, the yield of grain by fallowing was 81 per cent over the continuous cropping and that in straw was 85 per cent. The increase in all the years was statistically significant. At Hagari, as a result of fallowing, there was an increase in the yield of the grain of *sorghum* to the extent of 50 per cent and straw to the extent of 38 per cent. These figures represent the average of three years. The increase in grain yield was statistically significant in all the years.

Combined effect of all operations

At Bijapur, the method of cultivation consisted of (a) ploughing once in three years, (b) bunding and division of land into compartments, (c) addition of five cartloads of farmyard manure at least in alternate years, (d) sowing with a wider seed drill at a low seed rate and (e) interculturing the crop for four or five times. The average yield per acre was 654 lb. grain and 938 lb. of straw of *rabi jowar*. Comparative analysis of the results showed that increase in grain yield varied from 50 to 190 lb. per acre due to manure, according to the type of soil. The money value of the *jowar* crop amounted to Rs. 24-12-2 per acre. In the same area the local cultivator's method gave an average yield of 302 lb. of grain and 463 lb. of straw. The local cultivator used wooden plough instead of the iron plough, gave less number of harrowings, did not bund and divide his lands into compartments, used narrow seed drill with higher seed rate, did not apply farmyard manure and gave only two interculturings. The Bombay method included five important items, viz. deep ploughing, raising of small bunds, broad sowing, use of graded and dusted seed and interculturing. Increased yields ranging from 20 to 25 per cent have been obtained by this improved method of cultivation.

LENTIL AS GREEN MANURE

By M. R. FOTIDAR

IMPROVEMENT of soil fertility constitutes the most important factor in the programme of 'grow more food' campaign, and a good deal of attention is now being paid in conserving soil fertility and supplementing it by chemical fertilizers, compost, green manures, over and above the farmyard manure, which the Indian farmer has been applying as an age-long practice. Green manuring is recommended by the Agriculture Departments but so far, in most parts of the country, the practice is unknown, for one reason or other. The cultivators do not know what crops to use as green manure and when to grow them to fit in in their cropping schemes. In the Kashmir Valley, like other places, which have long and cold winter season, the problem is still more complicated because in five months in a year the vegetative growth practically ceases. Green manuring of *kharif* crops is not considered to be practicable, and for *rabi* crops, wheat, etc. it is practicable, unless green manuring crop is grown in summer months (April to August), and irrigation water is available. Unfortunately wheat is raised as a *barani* crop where the possibilities of raising green manures in the field are very limited. Besides, wheat is grown in rotation with maize, and practically no time is left in between harvesting of maize crop and sowing of wheat. Rice being the principal food crop in the Valley, the Department has been conducting experiments in green manuring and such *rabi* green crops, which could survive winter snow and make quick growth in early spring before land is puddled for rice, were tried, i.e. peas, *sarson* (*Brassica compestris*) and lentils (*Lens esculenta*).

Out of all green manures, lentil alone could be grown economically. The experiments conducted during the last four years yielded results which are detailed below.

Manurial trials

The experiment was conducted for five years, 1941-42 to 1945-46, with the following treatments :

(i) Farmyard manure at 68 lb. nitrogen per acre.

(ii) Ammonium sulphate at 68 lb. nitrogen per acre.

(iii) Farmyard manure plus ammonium sulphate at 68 lb. nitrogen per acre.

(iv) Gypsum at 336 lb. per acre.

(v) Gypsum plus farmyard manure at 68 lb. nitrogen per acre.

(vi) Lentil (green manuring) at 68 lb. nitrogen per acre.

(vii) Control.

The results have been as under :

1941-42 : Lentils and ammonium sulphate at the rate of 68 lb. nitrogen each per acre yielded about 31 per cent more than control.

1942-43 and 1943-44 : The yield was in favour of lentils by an increase of 43 and 45 per cent respectively.

1944-45 and 1945-46 : The increase in yield has been 10 and 4 per cent respectively again in favour of lentil as a residual effect when no additional application of manures as mentioned above was made. During these two years, it has also been noticed that the application of ammonium sulphate has stood last in the test.

Soil fertility experiment

This experiment was also conducted for three years, 1943-44 to 1945-46, with the following treatments :

(i) Paddy after oilseed crop (rape)
(ii) Fallow (ploughed during winter)
(iii) Fallow (uncultivated during winter)
(iv) Lentils (green manuring).

In 1943-44, green manuring with lentils yielded 35 per cent more than control, and in 1944-45 and 1945-46, the increase in yield was maintained to the extent of 24 and 25 per cent respectively.

In the year 1944-45, another new manurial experiment was carried out on equal basis of nitrogen, in which ammonium sulphate, oilcake and farmyard manure in two doses (75 lb. and 90 lb. nitrogen per acre) were used. Lentil (90 lb. nitrogen or 1,336 lb. of green manure per acre) has given a net increase of

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900 lb., that is 40 per cent, above control plots, thereby yielding a net increased profit of Rs. 34 per acre. All the other treatments resulted in increased yields, but owing to high cost of fertilizer, particularly ammonium sulphate and oilcakes, there has been actually net loss.

Manuring with lentils

Lentils when grown for green manuring are sown in October, a fortnight or three weeks after harvesting paddy crop. The seed is broadcast at the rate of 16 to 20 seers per acre. On an average, a normal crop yields about 3,900 lb. green material at the time of ploughing the crop in. The crop gets maximum vegetative growth when it begins to flower, sometimes towards the close of April. A heavy plank (*Sohaga*) is run over it to level the crop with the ground. Immediately after levelling it, the crop is buried with a furrow-turning plough. The ploughing follows the direction the plants are laid in the ground, so that the crop is conveniently covered by the furrow. To have a clean operation, it is advisable to irrigate the fields a few days ahead. The fields green manured thus, get ready for puddling within two weeks after the crop is buried in it. The cost of cultivation of this green manure does not exceed Rs. 5-8 per acre which includes two extra ploughings, cost of seeds, levelling, etc.

In the Kashmir Valley, there are about ·48 million acres of land under rice crop. Out of this area, about 15 per cent is double-cropped, where rape-seed is grown as a *rabi* crop. About 40 per cent of the area is not suitable for lentil cultivation, because either the area remains a swamp during winter and early spring or is situated at higher altitudes where there is paucity of irrigation water. Thus the remaining area of about 50 per cent, that is ·24 million acres can easily be green manured with lentils within the next two or three years. On the basis of a conservative estimate, this green manuring with lentils will naturally result in increased yields of rice to the tune of about ·8 million maunds of paddy. About ·14 maunds of lentils will be needed to complete the sowings for green manuring and it would not be difficult to produce and spare this quantity for sowing in the subsequent years. No doubt this is an uphill task, but with additional district staff, it does not appear to be difficult. In the present crisis of food deficit, early steps should be taken to give immediate effect to this scheme.

NEW MECHANICAL POTATO PLANTER

A NEW potato planter claimed to be accurate to within half-an-inch is now being marketed in Britain.

The principle of the machine—on the development of which £70,000 (Rs. 9·33 lakhs) was spent—is that it lays potatoes on the ground instead of dropping them. This reduces the 'rolling' of tubers on the soil to a minimum and accounts for extreme accuracy.

The planter is a three-row model and weighs 8 cwt. (*B.I.S.*)

SOIL CONSERVATION IN INDIAN AGRICULTURE

By P. V. C. RAO

THE agricultural backwardness of our country is directly attributable to the rapid depletion of our soil. Our cultural practices have always been wasteful in their application. The intensive exploitation of the land for maximum gain by the transitory type of tenants, and the utilization of slopes which should, by virtue of their topography, remain under grass or forests, have been responsible for the rapid loss of fertility of our soils.

Soil depletion may result from the extraction of chemical elements from the soil, from the breakdown of the soil structures, or from the actual removal of top-soil. Crops gradually remove the elements of fertility from the soil, and methods of tillage and rotation have an important effect upon soil structure. Erosion by wind or water removes the entire body of the soil.

The insidious process of soil depletion is little known to our farmers, and therefore millions of acres have already been completely spoiled. It is entremely important to recognize that we are today faced with a destructive process of soil depletion. The problem therefore is not merely to remedy the condition of the soil which is already bad, but to forestall a far more serious improverishment by checking the forces that are devastating the soils.

Soil erosion is the most easily recognized force of soil depletion. Deepening gullies, such as the awesome chasms, that are manifest in the Deccan Plateau, or the bewildering dust storms of the Central Indian plains, the devastating floods of the Bihar and Assam valleys and the rapid sedimentation of our irrigation canal systems as well as harbours are ample proofs of the menace of soil erosion. The rapid decline in soil productivity should be evident from the gradual drop in crop yields. Where however efforts are made to maintain the level of crops at least as a temporary measure by boosting the fertility through artificial fertilizers, and by other agronomic practices, the costs of production have necessarily shot up thus rendering agricultural operations uneconomic. We have been clamouring for imports of artificial fertilizers and our research institutions are making tremendous advances in improved agronomic practices making use of fertilizers with the object of increasing production, but the rapidly decreasing soil fertility through soil erosion will obviously offset all the benefits that will otherwise accrue from the application of improved agronomic methods. When soil depletion renders the land unfit for economic cultivation, the land is relegated to the submarginal class. There is a volume of acreage of such submarginal land in our country.

As soil erosion is menacing agriculture on a national scale, it is imperative to combat it on a similar scale. A National Soil Conservation Programme should therefore be evolved for the treatment of the land according to its adaptabilities. For soil defence all necessary productive measures of agronomy, engineering and farm management should be taken. Such a mass-scale application should necessarily call for concerted measures for rousing public opinion to the gravity of the problem, and also to the urgency of the solution. Unless the wholehearted cooperation of the tiller of the soil is forthcoming, the enforcement of the application of the various conservation methods will become extremely difficult.

In America, the programmes started in 1933 with the formation of the Federal Soil Conservation Service. In the first few years, the Service entered into what were called cooperative agreements with individual farmers for treatment of individual farms. The necessary finances were made available for the farmer by the Agricultural Adjustment Administration. Rapidly these individual agreements have given place to Conservation District Cooperatives which are organized and run by the farmers' elected representatives. The Soil Conservation Service gives technical guidance to the farmers. While the principle of individual treatment of farm as a unit is scrupulously observed, enlightened farmers agree to combined

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operations of contour-terracing, etc. on considerations of the topography and soil quality of the land, irrespective of field boundaries. Nevertheless, such joint efforts are rather an exception as the average American farmer is highly individualistic.

In India the problem of soil conservation was taken up in 1935 by the Punjab Government. Though mass-scale operation was not contemplated, its Forest Department took up a part of the programme mainly from the forestry point of view. Much useful work was done for the prevention of bank erosion and also in the groyning of rivulets. The Government of Bombay had started the land improvement scheme on a small scale in the year 1939, and as a result of innumerable experiments conducted in these fields, mass-scale contour-terracing and contour-trenched afforestation were started in 1943. An Institution for training the staff required for the Department was started and it has subsequentl developed into a bigger institution for th training of the employees deputed by th other Provincial and State Governments. I is a homogeneous organization consisting o engineering, agriculture and forestry and lan record sections. Mass-scale operations with out any regard to the field boundaries hav been developed under the Bombay Lan Improvement Act. Bombay can rightly clai to have been the pioneer in the field of so conservation and land improvement on national scale, and it is high time that ou Central Government starts a Central So Conservation Service and undertakes effectiv central legislation for a national programme o soil conservation and land utilization. If onl we spend a fraction of what we are now spendin for the food imports, we can achieve results o a far-reaching consequence in the field o agriculture on a permanent basis.

SNIPPETS ON FOOD AND AGRICULTURE

1. A TOTAL of 625 acres of wasteland in different parts of the country is being ploughed up every day by units of tractors supplied by the Central Ministry of Agriculture.
2. For every 28,000 tons of wheat procured within the country, India saves Rs. 1 crore worth of foreign exchange.
3. Nearly 83 per cent of the cultivated area in India is under food crops. Of this 31·6 per cent is under rice, 29 per cent under millets and other cereals, and 14·7 per cent under wheat.
4. During 1948 the Central Food Ministry distributed 32 lakh tons of foodgrains to deficit areas in the country.
5. After partition, India has to maintain 78 per cent of her original population on 71·7 per cent of the original area under rice and 71 per cent under wheat.
6. The largest and oldest forest college in the East is situated in India, at Dehra Dun. (*P.I.B.*)

What the Scientists are doing

FREEZING POINT TEST FOR DETECTION OF ADULTERATION IN MILK

A SCHEME of the Indian Council of Agricultural Research with the object of finding out the average and the variations in the freezing point of milk from indigenous breeds of milch animals and testing the applicability of this method for detecting adulteration of milk has recently been completed at the Indian Dairy Research Institute, Bangalore. Samples of milk from the farm animals which received balanced ration and from ordinary animals from rural and urban areas were tested. In samples collected from distant centres suitable preservatives which are known not to affect the freezing point of milk were used. The test was also carried out, in the case of milk of buffaloes, sheep, and goats. Over 750 samples of milk from Gir, Sahiwal, Sindhi, and Tharparkar, cross-bred cow, Dharwar and Murrah buffaloes, were examined. The average freezing point was 0·548°C. for cow-milk and 0.549°C. for buffalo-milk. Two hundred and forty-three cow-milk samples and 58 buffalo-milk samples from different parts of the country were tested and the average freezing point in case of cow-milk sample was 0·542°C. and in case of buffalo-milk 0·538°C. In case of some individual animals samples were tested on alternate days, throughout the entire actation period, but no change in the freezing point was observed due to change in season. There was no difference in the average freezing point of milk from different breeds of cows, and average figures of freezing point of cow and buffalo milk samples appear to be similar. Development of acidity in milk lowered the freezing point. It has therefore been suggested that the samples which are to be examined by freezing test should not give a positive boiling test and nor its titrable acidity exceed 0·19 per cent lactic acid. No difference was observed between the freezing point of whole and separated milk. Pasteurization either by Holding or Flash method, did not affect the freezing point, though the boiling lowered the freezing point, which increased with the length of boiling. The effects of various preservatives on the freezing point were tested, and Mercuric Chloride in the concentration of 0·0755 per cent was recommended for preserving milk to be used for the determination of the freezing point.

By the freezing point test an addition of 3 per cent of water can be detected. Assuming the average freezing point of milk as 0·35°C. the average freezing point of sheep and goat milk was found to be lower than that of the cow or the buffalo. The average freezing point of goat's milk was 0·575°C. and that of the sheep 0·588°C. The results of these tests are to be communicated to the various municipalities and health organizations for trial. (H.K.L.)

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Have any experiments been conducted in India on the feeding value of sugarcane tops? What is the effect on milk yield?

A. From the estimates of the area under sugarcane in India it appears that 4,234 thousand acres were under sugarcane during the year 1943-44, and if the average yield is taken as 12·96 tons per acre, the total yield of sugarcane tops is expected to be 54,880,000 tons per year. With common cultivated grasses, it would require about 833,000 acres to produce the same amount of green fodder, if the yield per acre is taken as 7·32 tons. This shows that the green forage available from sugarcane tops is considerable. Experiments to find out the feeding value of sugarcane tops have therefore been carried out at the Animal Nutrition Research Station, Bharari, on Hariana cows.

The composition of the sugarcane tops shows that they contain 3·21 pounds of protein per 100 pounds of dry matter as compared to 2·55 pounds for *jowar*, 4·44 for maize, 3·58 for Elephant grass, 3·4 for Guinea grass; 55·26 lb. carbohydrates which is comparatively higher except in the case of maize, which contains 61·01 pounds of carbohydrates for 100 pounds of dry material. Thus the total digestible nutrients compare very favourably with some of the fodder grasses and *jowar*.

Sugarcane tops were fed along with some linseed cake. The effect of feeding sugarcane tops on milk yield was studied on six animals for a period of 35 days. The results show that the milk yield is quite satisfactory, even when the amount of oilcake supplement necessary with wheat straw is reduced by 50 per cent, while feeding the sugarcane tops. —(H.K.L.)

What's doing in All-India

JAIPUR

CHATTAR SINGH SIDHU

JAIPUR State, with an area of 15,601 sq. miles, and population of 30,40,876, is an important State situated in the centre of Rajputana. About one-third of its area on the north-west adjoining the Bikaner and Jodhpur States consists of poor soil varying from light sandy loam to almost pure desert sand with scanty and uncertain rainfall. The remaining two-third area on the east and south having rich loamy and clayey soils, is quite fertile and productive with annual rainfall of 30 in. or above. The average annual rainfall for the whole State is however 24 in.

The Department of Agriculture existed in a miniature form in this State under the charge of an Agricultural Officer since a long time, but no tangible work was done till the year 1944, when the Jaipur Government secured the services of Sardar Sahib Sardar Labh Singh from the Punjab, and appointed him as the Director of Agriculture. Work of this Department was then replanned and reorganized. Technical staff for the various Research Sections was recruited, field staff was increased and new experimental farms were opened. There had been a considerable difficulty in securing technical and trained staff.

Training of staff

To overcome this difficulty, State nominees were sent to Agricultural Institutions outside the State to qualify at State expenses. Six of them are at present getting training for B.Sc. (Agri.) at Amritsar, Delhi, Kanpur and Allahabad Agricultural Colleges. One State nominee is undergoing two years' Post-graduate training at the Indian Agricultural Research Institute, New Delhi, and one is receiving higher training in advanced agriculture at the Texas University in the U.S.A. Three young men sent to the Indian Dairy Research Institute, Bangalore, have already come back after completing successfully their two years' course of I.D.D., and have joined the State services. Four young men got one year's horticultural training at the Government Gardens, Saharanpur, and have since been appointed as Head Gardeners.

As sufficient seats could not be available at the Agricultural Colleges, some staff is also being trained locally. Two classes, one of inspectors and the other of sub-inspectors, were started in February, 1947.

Wheat

The typical Jaipur indigenous wheat is a mixture of Durum and Vulgare varieties, predominantly red, and of thin and shrivelled nature. On milling, this wheat yields flour with a high percentage of bran which makes rough and stiff *chapatis* or *puris* of red colour. This wheat is also a poor yielder and is highly susceptible to rust attacks. Improvement in wheat crop was attempted by importing C. 591 wheat from the Punjab and testing it against the local wheat.

After two years' thorough and systematic trials at the Government Agricultural Farms and cultivators' fields during 1944 and 1945, C. 591 was found quite suitable for local conditions in Jaipur. Seven thousand maunds of this wheat were arranged from the B.C.G.A. Farms at Khanewal (now in Pakistan) in 1946, and distributed for the first time on a large scale in all the wheat-growing *tehsils* of the State. This wheat has since become very popular and has established its superiority over the local wheat, because of its following characters:

(1) It suffers much less from rust (*roli*).
(2) It has got strong stalk and does not lodge.

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(3) Grain of this wheat is amber-coloured, which yields white flour making soft and white *chapatis* and *puris*. It fetches a considerably higher price than the local wheat.

(4) It stands cold better than the local wheat.

(5) It gives higher yield of grain as well as of straw or *bhusa*.

In 1946-47 the average increase in favour of C.591 was 1 md. and 38 seers per *bigha* which is equal to 3 md. and 4 seers per acre, and in 1947-48 3 md. and 22 seers of grain and 5 md. and 6 seers of straw per *bigha*, which means 5 md. and 27 seers of grain and 8 md. and 8 seers of *bhusa* per acre.

The average results of the experiments are given in the Table below.

Place	C. 591								Local							
	Yield of grain				Yield of *bhusa*				Yield of grain				Yield of *bhusa*			
	Per *bigha*		Per acre		Per *bigha*		Per acre		Per *bigha*		Per acre		Per *bigha*		Per acre	
	Md.	sr.	Md.	sr.	Md.	sr.	Md.	sr.	Md.	sr.	Md.	sr.	Md.	sr.	Md.	sr.
Paota	8	26	13	34	21	18	34	16	3	15	5	16	12	4	19	14
Khawa	15	11	24	17	32	8	51	21	5	36	9	17	24	2	38	29
Khilchipur Sherpur	9	8	14	27					8	18	13	21				
Hindaun	4	7	6	27					3	1	4	34				
Phagi (irrigated)	5	5	8	8					1	24	2	24				
,, (*barani*)	5	33	9	13					4	0	6	16				
Kanwat	10	31	17	9					7	21	12	0				
Hanspur	7	8	11	21					4	14	7	0				
Chandel	9	8	14	27					3	20	5	24				
Durgapura Farm	15	9	24	14	31	11	50	0	11	24	18	24	28	10	45	8
Basi Farm	10	12	16	19	22	23	36	5	8	34	14	8	22	20	36	0
Average	9	8	14	27	26	35	43	0	5	26	9	0	21	29	34	32

(A *bigha* is equal to 5/8th of an acre.)

As a result of its marvellous performance and the confidence and popularity it has gained with the growers, the area under this wheat is fast increasing. It was estimated to be 40,000 *bighas* (25,000 acres) during 1947-48, i.e. only two years after introduction. Demand for seed of the new wheat is becoming very great, so much so that the State Department of Agriculture with its limited resources is finding it difficult to meet. A target of 25,000 md. seed was fixed to be collected for next year's distribution, but in spite of all efforts, 11,929 md. seed wheat could only be recovered or purchased at the harvest time in the State. Efforts were then made to import 15,000 md. seed wheat from Faridkot State in the East Punjab through the allocation made by the Central Government, but actually 7,000 md. could only be secured, thus making a total of 18,929 md. for the next crop of 1948-49. With this crop in the field, it is estimated that about 60,000 acres have been covered by C.591 in Jaipur State.

Side by side with the above developments, valuable research work is in progress. Local wheat had been crossed with C.591, and the progeny has been studied in F_3. Some of the crosses are very promising with the combined desirable character, i.e. rust-resistance, strong straw, good quality grain of C.591 and earliness, drought-resistance and suitability for poor wheat lands of the State.

A number of N.P. wheats received from the Head of Botany Division, Indian Agricultural Research Institute, New Delhi, have been under trial against C.591 and local both at the Departmental Farms and at cultivators' fields in the districts. N.P. 718 has proved to be the best. The mean result of all the trials is given below.

Variety	Average yield of grain			
	Per acre		Per *bigha*	
	Md.	sr.	Md.	sr.
C.591	12	30	7	39
N.P. 718	12	4	7	23
Local	7	28	4	33

Some crosses of American rust-resistant wheats sent by the State nominee (Mr. T. C. Kala) from U.S.A. were also grown for observations. C.591 has been crossed with one of these called 'Sea Breeze', and some promising plants have been selected for further work.

Barley

Having the largest area under cultivation in the *rabi* season and being the staple food of masses, barley is a very important crop of the State. A variety C.251 imported from Kanpur has been under trial for the last three years; it has now definitely proved better than the local variety, both at Government farms and in Zemindars' farms in the districts, with an average of 27 md. and 7 seers against 24 md. and 35 seers of local per acre. Last year the increase in favour of C.251 over the local was 3 md. and 10 seers per acre. Largescale distribution of this barley seed has been started in districts.

A number of selections from the local seed have also been made. A few of these, viz. J.B.S.20, J.B.S.30 and C.84 are faring well for the last two years. Trials are being continued.

Gram

As a staple food in the State, gram occupies the second place. Improvement in this crop is also being attempted by importing improved varieties from outside and by making selection from the local crops. N.P.25 (an imported variety) and local selections No. 9 and 10 did definitely better than the local; No. 10 yielded 3 md. and No. 9, 1 md. and 3 seers per acre more than the local. The N.P.25 variety also yielded 1 md. and 15 seers per acre more than the local. Moreover, the local selections have good yellow colour and bold grain, and have also been found to stand frost better. Trials are being continued.

Zeera

White *zeera* is a money crop of considerable importance in this State, having an area of 22,288 *bighas* under cultivation in the Khalsa territory. A local selection K.1 of this crop has been under trial for a number of years and has successively proved better than the local. The results are given in the Table below.

Variety	Average yield			
	Per acre		Per *bigha*	
	Md.	sr.	Md.	sr.
K.1	6	24	4	25
Local	5	13	3	13

Seed of this variety of *zeera* is now being issued for general distribution to growers.

Sugarcane

Though grown on a limited scale at present in this State, sugarcane has enormous scope for future. *Gur*, being an essential item in the diet of masses, large quantities are every year imported from the United Provinces. Four years back Coimbatore varieties were tried against local cane at the farms. Co.312 was found to be the best in all respects. Co.312 has since been distributed by this Department to the cultivators on a large scale. Owing to its high yield of *gur*, capacity to grow Ratoon (*Pedi*) and to flourish exceedingly well in the beds of rivers and *nallas*, the Coimbatore cane has now completely replaced the local variety. The area under this cane has also increased several folds. The total area under sugarcane (now all Co. 312) during 1948 is 9,616 against 2,097 acres (all local) in 1944. About 5,000 md. of seed canes of Co. 312 are distributed every year by the Agriculture Department to localities where it was not previously grown.

Popularity of the Coimbatore cane has also given rise to the manufacture of white sugar. About half a dozen small open-pan system manufactories were at work last season in the State.

Cotton

The southernmost part of the State has black clayey soil, which grows the major part of the cotton produced here. The indigenous type is a late ripening variety of cotton with rough and short fibre.

C. 520, a United Provinces variety of *desi* cotton and a Ganganagar selection of the same, were introduced a few years back. Because of their higher yield, better ginning percentage, and superior quality of lint, these improved varieties have covered half of the total area under cotton crop. Fifty maund of seed of these varieties are distributed by the Agriculture Department every year.

Selections from the local variety have also been made. A selection No. 2 has been found promising. Further trials are being continued.

Some varieties of long staple cotton were imported from outside. Besides other qualities, some of these varieties are outstanding for their early ripening characteristics. Results of performances are recorded in the Table below. Work is being continued with interest.

Varieties	Average yield							
	Durgapur Farm				Basi Farm			
	Per acre		Per *bigha*		Per acre		Per *bigha*	
	Md.	sr.	Md.	sr.	Md.	sr.	Md.	sr.
C. 520	21	10	13	11	16	15	10	9
F. 238	14	5	8	35	15	16	9	25
F. 199	13	22	8	19	14	31	9	2
F. 107	13	0	8	5	12	36	8	3
Perso-American	9	0	5	25	6	4	3	33

Bajra

Bajra is the staple food of the masses in the State. Mass-selection was done from the local variety a few years back at the Basi Farm. This selection having been tried against the local gave a 20 per cent higher yield. Another variety T. 5 was imported from the Punjab and also tried against the local. This selection also proved better with 15 to 25 per cent higher yield. Seed of both the varieties are now being distributed to cultivators on a large scale. Two other varieties—Jamnagar Giant and 207—were imported from Jamnagar and were tried against Basi mass-selected and T. 5. The results, however, were not promising.

Fruits and vegetables

Jaipur State is extremely backward in fruit-growing and fruits are, therefore, very scarce and costly here. An experimental fruit garden was started in 1945-46. Thirteen and a half acres have since been planted with important varieties of mango, malta, oranges, lemons, limes, grapefruit, etc. which have not yet come into bearing.

Two fruit and vegetable nurseries have been started in two of the four districts of the State and proposals are under way for the planting of two more nurseries in the remaining districts. Fruit plants and vegetable seeds are being raised at these nursery farms and at the Experimental Fruit Garden. Fourteen thousand plants in 1946-47 and 19,000 in 1947-48 were distributed at concessional rates to the interested fruit-growers in the State. One thousand three hundred and forty-six and 1,600 lb. of vegetable seeds were supplied to vegetable-growers at the cost price in the years 1946-47 and 1947-48 respectively by the Agriculture Department and demand for such seeds is increasing every year.

Potatoes were introduced into this State a few years back by the Agricultural Department. About 500 md. of seed potatoes are imported from Bihar and the United Provinces every year, and distributed at cost price. The area under this crop in the State is 50 acres. Five hundred to seven hundred maunds of vines of sweet potatoes are also supplied to growers annually at cost price.

BIHAR

S. M. ISHAQUE

THE largest cattle fair of the world is held every year at Sonepore in the Saran District of Bihar. The fair is held in conjunction with the *Kartik Purnamasi* festival and lasts for a month. Lacs of people from all parts of Bihar gather at Sonepur, to take a dip in the holy Ganges where it joins with the river Gandak. The gathering of so many people on this occasion increases the grandeur of the Sonepur Cattle Fair which is known locally as *Chatar-ka-mela*. The fair is held on the bank of the river Ganges near the Sonepur Station on the Oudh and Tirhut Railway. There is a vast open space to accommodate the congregation of men and animals. High Government Officials, leading zemindars of Bihar and other ruling chiefs of India gather there and pitch their respective tents to witness the fair. The cattle-dealers from various provinces are also seen in number.

This year the fair was held in the middle of November. Lacs of animals of different species from all over India were brought to the fair. The animals comprised mostly of elephants, horses, camels, cattle of different breeds and goats. One interesting feature of the fair was the presence of a large variety of birds. Owing to the partition of the Punjab, the number of cattle from the Western Punjab was less, though cattle from Hissar, Rohtak and Gurgaon Districts in the East Punjab came in large number.

A veterinary stall was organized by the Animal Husbandry Department, Bihar, and illustrations, maps, models and specimens of different breeds of cattle were kept for demonstration to the public.

Veterinary activities

Arrangements are being made to start model *gaushalas* on Wardha lines. One *gaushala* has already been started at Patna at Sadaquat Ashram. The *Gaushala* Development Officer is touring in villages and making plans to start *gaushalas* as early as possible. The Animal Husbandry Department is also distributing Hariana bulls to the *gaushala* to improve the breed of the livestock.

The Bachaur Cattle Breeding Farm at Patna is progressing well.

The Poultry Development Officer has started a small farm at Gaya as a nucleus for the Central Poultry Farm to be established at Patna.

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THE DAMODAR SCHEME*

THE importance of the Damodar Scheme as a nation-building enterprise has been discussed almost threadbare during the past few years. It has been repeatedly emphasized in official conferences and *communiqués*, in the debates in the Central and Provincial Legislatures, in responsible public utterances, in the public press. The importance which the Government of India attaches to this Scheme found a unique recognition not long ago in the passage by the Central Legislature of the Damodar Valley Corporation Act which set up an autonomous public Corporation and entrusted it with the execution of the Scheme. The Corporation which was formally inaugurated on 7 July last is now vigorously pursuing the Scheme in fulfilment of its statutory assignment. There should, therefore, be no need at this stage to re-open a discussion on the benefits of the Scheme, far less to make out a case in its defence as a productive enterprise. For convenience sake, however, it may be desirable to mention briefly the salient features which entitle the scheme to the pride of place among India's development projects.

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* Received from the Damodar Valley Corporation.

Flood

Though the Damodar is a relatively small river, the flood damages caused by it in the past have been exceptionally severe. Agriculture in the Lower Valley suffers from monsoon floods almost every year. The damages are particularly heavy in years of devastating floods which occur periodically. Such floods are a perpetual threat not only to the main arteries of rail and road communications, but also to the city of Calcutta. Because of the high fertility of agricultural land in the Lower Valley and of the large amount of capital already invested in the area exposed to the flood hazard, the damages likely to be caused by floods are proportionately far more serious than almost in any other river valley in India. As a flood insurance policy the justification of the Scheme is obvious as it will insure high values representing the landed property and the fixed capital assets, against flood contingencies at a comparatively low 'premium'.

Food

The regulated Damodar will make it possible to service at least 9 lakh acres of fertile alluvial soil with perennial irrigation, some being inclined to accept a substantially higher figure. About a fifth of this area is already under full or partial *kharif* irrigation. On the other hand what are fallow and waste lands now will be available for cultivation after the elimination of floods and the provision of irrigation facilities. The contribution which the Scheme can make to solve the present food shortage in the country can be judged from the following:

(i) The additional output of rice that can be produced in the Valley may be conservatively estimated at 50 lakh md. or about two lakh tons per year. The gross money value of this extra output will amount to:

Rs. 5·0 crores @ Rs. 10 per md.
,, 7·5 ,, @ Rs. 15 ,, ,,
,, 10·0 ,, @ Rs. 20 ,, ,,
,, 12·5 ,, @ Rs. 25 ,, ,,

(ii) There is no reason why in the long run year-round cropping should not become the practice in this region. As is well-known, per acre income is much higher for most *rabi* crops than for rice. Even assuming that only one-half of the total irrigated area will grow a second crop, the additional income should easily amount to 50 per cent of the value of the additional rice output as estimated above.

(iii) The long-term land-use programme of the Corporation will include such measures as water control on land, erosion control, scientific crop rotation coupled with a drive for increasing the intensity of cropping, use of manures and fertilizers, mixed farming, a gradual switch-over to compact and more economic holdings, and other readjustments that may be necessary to raise agricultural income. As a result of such measures which could be best carried out jointly by the Provincial Governments and the Corporation the output of crops and income per acre should in the long run rise much further than has been shown above with a corresponding rise in the gross value of the total agricultural produce.

(iv) Possibilities for fish cultivation will greatly increase as a result of the Scheme. If the reservoirs, river channels, irrigation canals, and the numerous tanks and ponds are properly utilized for the purpose, the Valley will become a substantial source of fish supply which would go a long way to meet the requirements of the industrial areas in and around the Valley as well as of the large Calcutta market.

Power

The combined hydro and thermal capacity under the Scheme will amount to about 400,000 KW. The abundance of coal will make it possible to step up power output as the load increases, by setting up additional thermal stations. The thermal plant at Bokaro with 200,000 KW capacity will be erected first. Tenders invited for this power plant have already arrived. It should be possible to bring this plant into commission within three to four years' time.

Coal conservation

For a large country like India her coal resources are by no means too large. The deposits of high-grade metallurgical coal are definitely limited, especially when compared with her future potential requirement. It is, therefore, of the utmost national importance to conserve high-grade coal to the maximum possible extent. Action in this field has long been overdue. The Corporation proposes to devote special attention to this problem and will accordingly (i) use coal with high ash content in the steam power plants including that at Bokaro, and (ii) take steps to facilitate the electrification of the railway system as far as possible so that large quantities of high-grade coal now consumed by the railways may be released for the metallurgical industry.

Transport

Transport is today one of India's most serious bottlenecks. Traffic congestion is almost at its worst in and around the Damodar Nalley. At present the railways cannot cope with the transport even of such key materials as coal and iron and steel. The Damodar Scheme will make a significant contribution in two respects in solving the transport problem :

(i) The electrification of the railways, say between Calcutta and Moghulsarai, will greatly relieve traffic congestion by cutting down the volume of coal shipments and making possible faster and more frequent train movements.

(ii) The 80-mile long navigable channel connecting the Damodar at Durgapur with the Hooghly about thirty miles above Calcutta will be another important factor in cheapening transport and relieving traffic congestion in this vital area.

Industrial and domestic water supply

The Damodar is a seasonal river, its dry weather flow being negligible. Lack of assured water supply has undoubtedly been a direct cause of the slow industrial development in the Valley. All over the world proximity to coal has been a powerful factor in industrial location with the result that coal areas, as a rule, are also the most important industrial areas. In India, on the other hand, coal areas have failed to attract industries sufficiently so that instead of industries moving to coal, only too often coal has to be moved to factories over long distances of congested railway lines. Harnessing the Damodar is, therefore, the first essential condition for realizing the high industrial potential of the Valley. It can be confidently predicted that, as soon as this seasonal river has been converted into a perennial one with a dry weather flow of 4,000 cusecs, many major industries will begin to spring up in the area. The enquiries that are already being received for power and water supply in connection with plans for the establishment of new industries, leave no doubt in this matter.

The communities on both sides of the river now suffer from an acute shortage of drinking water in the dry season. Some of the worst sufferers are the coal mining areas. The Corporation has already been approached on behalf of the Jharia and Raniganj coal mines, Asansol and other townships for an assurance that water in adequate quantities will be supplied from the Damodar at the earliest possible date.

Industrial development

With floods eliminated and abundant supply of water and power assured, one may safely reckon with the rapid development of many key industries in the Valley :

(i) The Damodar Valley is the mineral storehouse of India. It accounts for almost three-fourths of India's coal deposits and no less than nine-tenths of her present coal raisings; the rich iron ores of India are concentrated in and around this region; some of world's best mica is produced in the Valley; substantial deposits of bauxite are also available in this region. In addition there are deposits of a large number of other minerals. According to a special study made by the Geological Survey of India, there is scope for no less than 110 industrial units of different types in the Valley because of its mineral wealth.

(ii) The presence of large coal and iron ore deposits in particular invests this region with an overriding national significance. What happens to this area will, more than anything else, determine the output of coal and iron and steel in the country, and thereby also the pace of her future industrial progress.

The Damodar power system will make it possible to proceed expeditiously with the electrification of the coal mines. This will be a powerful factor in stepping up coal output and lowering its unit cost. If India is to rise in industrial stature, she will undoubtedly need several new iron and steel plants. Owing to the proximity of coal and iron ores, the Valley is the most logical site for such plants.

(iii) Similarly the Damodar region is potentially the most favourable site for a host of other heavy industries, for which coal and iron and steel are the basic raw materials. As examples mention may be made of the Loco Building Works Project at Mihijam and the Fertilizer Factory at Sindri, both of which recently been made by the Consultants to the Government of India about sites in the Damodar Valley in connection with the location of the proposed steel and synthetic oil plants. Development of several electro-chemical industries in this area is now being jointly planned by the Governments of Bihar and Bengal and the Corporation. In its industrial potentialities the Damodar Valley has the same significance for India as the Ruhr Valley for Germany and the Monangehala Valley for the U.S.A.

National defence

The importance of the Scheme for national defence can hardly be overstressed :

(i) It is still fresh in public memory how the flood havoc of 1943 which breached the G. T. Road and E. I. Railway and completely isolated Eastern India from the rest of the country, hampered the defence measures at a critical moment during the war. According to military experts, that flood alone was responsible for holding up operations on the Burma front by no less than six months.

(ii) It is a commonplace that the war potential of a country depends above all on key industries like coal, iron and steel, aluminium, chemicals, etc. The Damodar Valley, because of the abundant deposits of the key minerals, is destined to be the centre of most of the industries vital to national defence. Indeed it may well be regarded as India's potential 'arsenal of democracy'.

Solving water problems in a monsoon-ridden economy

Monsoon in a tropical country like India creates problems, the implications of which are not always fully appreciated. As the heavy rainfall concentrated practically in three months of the year beats the land, the top-soil is more easily eroded ; the high surface run-off strains the carrying capacity of the rivers which are largely silted up, and thereby aggravates floods ; with the rapid evaporation of soil moisture the land hardens and becomes unfit for crop cultivation in the dry months ; because of the inadequate depth of water year-round navigation becomes impossible except in the lower stretches of a few very large rivers ; in the dry months many areas have to depend on precarious sources of water supply, which not only causes hardship to the public but also acts as a seriously limiting factor in industrial development.

How to spread the rain that comes down in three months over twelve is a problem of the most vital concern to India. Obviously this can be achieved only when an entire river system from its source to the mouth is treated as a single unit and multi-purpose dams are erected at suitable sites to hold back adequate quantities of rainwater. Only in this way will it be possible—

(i) to flatten out the monsoon flow in order to control floods ;

(ii) to regulate the dry weather flow in order to maintain the maximum uniform depth in the river ;

(iii) to develop year-round navigation on rivers where at present it is either seasonal or does not exist at all ;

(iv) to introduce large-scale perennial irrigation for stepping up the output of food and other agricultural produce ; and

(v) to tap substantial water power from the multipurpose dams.

The Damodar Scheme represents the first attempt in India to provide a comprehensive valley-wide demonstration of water conservation and use on the above lines. For this pioneer demonstration work the choice of river could hardly have been better. The Damodar is a big enough river for the purpose and yet not too big while the economic potentialities of the Valley are not only among the highest in the country, but also immediately realizable because of the ready demand for power and water. Once a successful demonstration of comprehensive river harnessing has been provided in the Damodar Valleys with its manifold benefits, it will be easier to undertake similar experiments in other river valleys of the country in the light of the experience gained here.

Across the Borders

THE GROWING OF WATERMELONS

By A. C. ORMAN

WATERMELONS are one of the most popular summer vegetables. They may be grown successfully in most districts, except the highlands where the season is too short and temperature too low for best results. Warm coastal districts situated in the central and North Coast divisions, as well as inland districts west of the Dividing Range, provide the most suitable condition for the crop. Watermelons are destroyed by frost and are severely checked by cold changeable weather. The most suitable climate is one that has a long period of warm frost-free weather which is not subject to sudden fluctuations in temperatures, and is relatively free from cold westerly and southerly winds in the late spring. High temperatures are essential for the production of good quality melons. Although the moisture requirements of the crop are not excessive, it is important that an adequate and uniform moisture supply be maintained in the soil throughout the growing period.

Soils and preparation

Rich, deep, well-drained alluvials are generally regarded as the most suitable soils for the watermelons. Virgin soils are particularly suitable. Sandy soils in warm situations produce the earliest crops and the best quality melons.

The soil should be prepared over as long a period as possible. For best results the first working should be given not later than the winter. Work the soil eight or nine inches deep, and reduce it to a fine, moist condition just prior to sowing. Well-rotted farmyard manure, if available, should be thoroughly incorporated with the soil during the final preparation.

Sowing the seed

The seed is usually sown on the square, in group or hills spaced 10 or 12 feet apart each way. In the drier districts, where irrigation is not available, a wider spacing is desirable. About eight seeds are sown one to two inches deep in each group. When the plants are well-established they should be thinned to three to the group. The seed may also be sown in drills spaced 12 to 15 feet apart, and the plants thinned to about eight feet apart in the drill.

Under no circumstances should sowing take place until the soil is warm enough to ensure a satisfactory germination and the danger of frosts has passed. Germination may be hastened by shooting the seed, just prior to sowing, between two damp bags placed in a warm position. The seed should be sown when the seed coat splits at the end.

Early crops may be obtained by propagating the seedlings in earthenware pots, boxes, etc. and subsequently transferring them to the field when danger from frosts has passed. Sowing is carried out about six weeks before the normal time for sowing in the field and the containers should be placed in a hot bed to promote germination and growth of the seedlings. When transplanting, it is necessary to remove the whole block of soil from the container, taking care not to injure the roots of the seedling.

Fertilizers are recommended for most soils. Rich soils may only require superphosphate applied at about 4 cwt. per acre, but most coastal soils should be fertilized with a complete fertilizer at 8 cwt. per acre. The fertilizer should be thoroughly incorporated with the soil prior to sowing.

Watermelons should be cultivated frequently from emergence until the vines prevent further cultivating, to control weeds and conserve moisture. Irrigation should be given when necessary to keep the crop growing continuously.

Varieties

Hawkesbury Wilt-resistant is the most popular melon grown for commercial purposes. The melons are oblong, with light greyish green and darker green netted markings. The rind is thick and tough, the flesh is medium to deep red, sweet and fine textured.

Hawkesbury Wilt-resistant is a heavy yielder of large melons, average about 35 lb. in weight. This variety is highly resistant to Fusarium Wilt. It is very suitable for transport over long distances.

Market Wonder, which is an improved Kleckley's Sweet, is a favourite for local market and home consumption. The melons are large, long, cylindrical with a dark green skin. The rind is medium thick and the flesh bright red, crisp, and of excellent quality and flavour. It is a heavy yielder and transports fairly well. It is similar in appearance to Kleckley's Sweet but somewhat large and more suitable for market. It is susceptible to wilt.

Early Canada is popular because of its early maturity and relatively good quality. The melons are oval to round in shape and of medium size; the skin colour is a light green. The quality is good. This variety is synonymous with Early Yates, Early Sugar and Early Surprise. It is suitable for early production and the most suitable variety for growing in Tableland districts.

Angelino: There are black-seeded and white-seeded strains, which are identical in all other respects. Fruit is oval to round and of medium size, skin very dark green. The flesh is dark red, of attractive appearance and excellent eating quality. Angelino is an excellent variety for the home garden but not very suitable for transport; it is very susceptible to wilt.

Chilian: There are two strains of this variety, black-seeded and white-seeded, the former being the more popular. The outside colour is dark green with darker green strips. The flesh is bright red and the rind thin and tough. Chilian is fairly early maturing and very suitable for the home garden; it appears to do particularly well in inland disticts.

Other varieties are Kleckley's Sweet, Sugar Stick and Klondike; the first two have been largely superseded by Market Wonder and Hawkesbury Wilt-resistant respectively.

Harvesting

Ripeness may be determined in several ways. Changes of colour, especially of the portion of the melon which rests on the ground, is a useful guide, the colour changing from white to creamy yellow at maturity. The rest of the melon usually changes to a dull colour as maturity approaches. A hollow sound when the melon is rapped with the back of the hand denotes immaturity, whereas a heavy dull sound indicates ripeness. The dying of the tendril at the stem end is also a sign of maturity. The smooth appearance and the total absence of hairs on the stem which attaches the melon to the vine is also taken as a guide by some growers. However, the knack of telling a ripe melon comes with experience.

Pest control

The most serious pests are aphids and pumpkin beetles. The former should be controlled by spraying the vine with nicotine sulphate one fluid oz., white oil emulsion six fluid oz. to four gallons of water. Pumpkin beetles may be controlled by dusting the plants with derris dust or calcium arsenate one part mixed with 16 parts hydrated lime. Hydrated lime alone may be dusted on the plants to repel the beetles.—Reproduced from *Agricultural Gazette of New South Wales*, April 1948.

Home Gleanings

PRODUCTION EFFICIENCY IN AGRICULTURE

By S. V. DURAISWAMI

IT will come as a strange surprise to many of us to hear that efficiency of production in agriculture of the United States of America is anything but satisfactory. This is sought to be proved in an article entitled 'How efficient is American agriculture?' by Theodore W. Schultz in the *Journal of Farm Economics*, August 1947. This article would naturally provoke in us the desire to examine the efficiency of production in our agriculture, but with what standards we have yet to decide. Efficiency of production in agriculture is difficult to judge, unlike in well-established industries. In the latter, practically all the factors are controlled and the in-put and out-put in production are easily worked out in cash value and efficiency is determined in a simple manner. But in agriculture besides the known factors of capital and labour, there are unkown and uncontrolled factors of the soil and climate. Hence comparisons between crop and crop or between tract and tract in the strict sense will have no value. Only broad comparisons can be made to give us an idea of the efficiency of the controlled factors as implements, machines or human labour.

In the above article we have been given an opportunity to see how efficiency in agriculture has been judged in the U.S.A. The following Table shows one method of judging efficiency of production according to the human factor for the year 1939.

Region		Value of product per man equivalent in dollars	Relative to Pacific
Pacific ...	...	1,558	100
Mountain ...	...	1,423	91
W. N. Central	...	1,286	83
New England	...	1,244	80
E. N. Central	...	1,197	77
Middle Atlantic	...	1,129	72
W. S. Central	...	700	45
South Atlantic	...	608	39
E. S. Central	...	486	31

The West (Pacific) is said to be most efficient in production and hence the comparison. If the efficiency in the West may be taken to be good or very satisfactory, it is argued why it should be so low in other parts and this is termed 'mass inefficiency'.

Another Table published in the same journal is also interesting. It is as given below :

Size of farm	Total agricultural output per cent	Value of product per farm dollars	Farms total		Labour force per cent	Value of product per man equivalent in dollars in 1939
			No. in millions	Per cent		
Small farms	32·5	Up to 1,499	4·6	77	65·6	62 to 837
Large farms	67·5	1,500 and over	1·4	23	34·4	1,087 to 2,850

From the above Table it may be inferred that as it is in India the small farms of the U.S.A. are also not economically sound compared to the larger ones which really constitute two-third of the total agricultural output of the country, though they are only one-third in number. Hence it is concluded that 'farm people in the large group for the most part work hard and long, but their output has relatively little value; they are under-employed;

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their human resources are poorly utilized'. We are constrained to remark that U.S.A. is no better than India in this respect.

Again a comparison is made between the value of output per man in agriculture to that in manufacturing industry. The difference is found to be great, as much as 2 to 4 times of production in industry compared to the best production in agriculture. In India this difference is bound to be more. It is also interesting to study the comparison made between different countries of the world in the matter of man output in agriculture. The comparison is made with what is called Colin Clark's international unit for the year 1940. The following Table gives the figures.

Country		Productivity per male producer in terms of Colin Clark's international unit
New Zealand	...	2,444
Australia ...	...	1,524
Argentine ...	...	1,233
Pacific (U.S.A.)	...	1,102
U.S.A. ...	...	661
Denmark ...	...	642
Canada ...	...	618
Holland ...	...	579
Germany ...	...	490
Great Britain	...	475
France ...	...	415
Belgium ...	...	394

Figures have not been given for other countries or for India.

Turning to our country we are accustomed to compare production largely in terms of yield per acre. We have not come to the stage on economic studies in our country to compare overall efficiency of man, the most important factor in production, as has been done in the U.S.A. Such a comparison shows how human energies have been utilized in different degrees, how in most cases they have been wasted and how it is necessary, in national interest, to conserve it to the utmost by improving the methods of production. For this purpose we should judge the efficiency of production by taking into account the production per unit of human labour in-put. The average number of units of human labour employed in the production of a crop and the quantity or value per unit can be worked out. Such figures worked out for the same crop as paddy or *cholam*, grown in different tracts of the country when compared, will clearly bring out the different degrees of efficiency of the human labour in the different areas. It will be certainly revealing and we can draw our own conclusions in the matter of efficient or inefficient utilization of the valuable human labour. In the same manner, other crops, particularly the commercial crops, can also be compared. The great idea is to judge whether human energies in production have been utilized to same extent, or rather to produce the same value in every kind of production. If in the Pacific region the value per man is 1,558 dollars, it is not known why it should be only 486 dollars in the E. S. Central area? There is therefore great waste of human energies in other tracts resulting in mass inefficiency.

It is worth while working out production value figures per human labour unit with reference to some of the important crops of our province and draw relevant inference in regard to the efficiency in production. The following Table may be considered to be self-explanatory, and as a preliminary step in the understanding of the problem.

Crop	Total man labour in-put per acre	Total value of production per acre	Value of production per man labour	Period of production months
		Rs.	Rs.	
Paddy (Guntur) ...	32	240	7·5	5
Tobacco Virginia (Guntur) ...	58	764	13·2	6
Paddy (Coimbatore)	50	330	6·6	5
Combodia cotton ...	54	360	6·7	7
Cholam irrigated ...	52	260	5·0	3½
Sugarcane irrigated	150	1,900	12·7	12
Cholam dry (Guntur)	26	120	4·7	4½

Note: Woman labour employed has been converted into man labour in the ratio of 2 : 1.

The comparison made in the above Table is simple and straight and excludes from consideration many other inherent factors which affect production. In the American comparison, evidently, the production over one year per man equivalent in distinct tracts has been taken into consideration. This equivalent is probably arrived at as so many labour days on all the farms situated in a homogeneous locality and the total production on all the farms for the year divided by the number of man labour days will give the production per man equivalent. Applying the same procedure for our country we have to divide our province into so many homogeneous tracts, where production is more or less similar, and work out the number of man labour days in such farms for a given period or a year. Two women may be taken to be equivalent to a man. This requires detailed economic study of the holdings in every representative tract as has been done in America.

A comparison made on these lines, i.e. on the American model, gives a very good idea of the extent to which the human resources are utilized in each tract. The aim is naturally to conserve human energies and utilize them to the maximum production value during a given period. It implies the utilization of labour to the maximum efficiency possible and eliminate the slack period which is so common in the agricultural industry of our country. In tracts where the off-season periods are longer such as in the dry areas the value production per man equivalent is bound to be low, unless alternative industries are introduced to produce other goods of utility.

A detailed and comprehensive economic survey of hundreds of holdings in each homogeneous tract is a prerequisite for any study, in this or other directions and we are in this respect far behind the U.S.A. and other western countries.

In conclusion it should be pointed out that judging efficiency of production, particularly in agriculture, is no easy matter and sometimes may lead to controversy in the matter of standards to be set up, among economists interested in the subject. This article has been written as a preliminary discussion of the subject with a view to stimulate interest among students of agriculture and invite criticism from those who take interest in the economic and social improvement of agricultural labour in our province.—Reproduced from the *Madras Agricultural Journal*, May 1948.

RAIN BY RADAR

RADAR is being used by a group of Australian scientists from the Council for Scientific and Industrial Research in experiments with the object of making rain. They are concentrating on three phases:

(1) Studies of the effect of ‘ seeding ’ clouds with dry ice pellets.

(2) Study of clouds and cloud structure.

(3) Development of instruments to measure physical conditions in and around cloud.

There are, however, many problems to face. Speaking on the experiments, the Minister in charge of the Council for Scientific and Industrial Research, the Hon’ble J. J. Dedman, said : ‘ First you have to find the clouds. Then there is the prospect that some people in the area chosen for rain-making do not want rain, and the question arises whether the Government will be liable for damages for causing rain to fall ’.—*Agricultural Newsletter*, No. AGN/227.

Book Reviews

DISEASES OF COTTON IN INDIA

By B. N. UPPAL (Indian Central Cotton Committee, Bombay, 1948, pp. 33, Rs. 2).

THAT a crop which occupies an area of over 20 million acres in India should be attacked by several diseases due to fungi, bacteria, nematodes and viruses, is not surprising. Fortunately a majority of these diseases in India are of minor importance, only wilt and root-rot in certain provinces and States causing anxiety to the cotton-growers. But a disease of no importance today may grow into a menace tomorrow. The Indian Central Cotton Committee has, therefore, done well in bringing together the available information on these diseases and this bulletin, written by a distinguished investigator of cotton diseases, is a welcome addition to the scanty literature on the diseases of crop plants in India.

Under each disease the life-history and distribution are briefly stated followed by an adequate description and aetiology of the disease. Control measures, wherever they are known, are given and relevant references to important literature enhance the value of the bulletin. The sections on wilt and root-rot are naturally very exhaustive, while those on anthracnose and blackarm, which appear to be not as insignificant as was once supposed, have also been dealt with in detail.

It is hoped that in a second edition of this bulletin, there would be a sufficient number of coloured drawings and photographs to illustrate the diseases. Bulletins of this kind should have been distributed free to cotton-growers; instead a charge of Rs. 2, which is rather exorbitant, has been made, which is very much to be regretted. (B.B.M.)

FRUIT JUICE SOFTENS MEAT

TWO Sydney (Australia) men have patented a process for making an extract of paw-paw juice to make tough meat tender.

They are Roy Wiegmore and Ray McLagen, who have for 18 months been experimenting with paw-paw enzymes, which have power to digest proteins. They claim that their formula which is made up in tablet form will shorten the cooking time of cheap tough meat by a third and make it equal to the best cuts.—*Agricultural Newsletter*, No. AGN/227.

FOURTH SESSION OF F. A. O.

FULLER details are now available of the work of the Indian delegation to the Fourth Session of F.A.O., which was held in Washington in November. India's 8-man delegation was led by Mr. Dinkerrao Desai, Bombay's Food and Civil Supplies Minister with Mr. B. R. Sen of the Central Ministry of Agriculture as alternate. Among the honours which came to India at this Conference of 58 nations of the world, was the election of Mr. B. R. Sen as chairman of one of the three Commissions into which the Conference had divided itself, and also as one of the three Vice-Chairmen of the F.A.O Council for 1949. The other two Vice-Chairmen were Professor Meyer of the University of Paris and Dr Barton of Canada, both of whom had been associated with the F.A.O. since its inception. India was also re-elected to the F.A.O. Council by 34 votes against a total of 43 cast.

The major work of the Conference was done in three Commissions set up by it. The first was to deal with the principal issues arising from a survey of the current agriculture and food situation and to make recommendations to member governments, with a view to promoting the general objectives of F.A.O.; the second was to examine in detail the programme of work suggested by the Director-General of F.A.O. for 1949 and to make recommendations, and the third was to discuss the financial and other administrative matters of the Organization. Viscount Bruce of Melbourne was elected Chairman of the first Commission, Mr. B. R. Sen of the second and Mr. Wauters of Belgium of the third Commission. All the 58 member nations were represented in each of the three Commissions.

Commission II, whose Chairman was the Indian delegate, dealt with subjects of the greatest importance. Of a total annual budget of 5 million dollars, 3 million dollars are directly spent in the programme of work drawn up for the eight divisions of F.A.O. which fell within the purview of this Commission. These include Economics and Statistics, Agriculture, Forestry and Forest Products, Nutrition and the distribution of cereals through the International Emergency Food Council. This Commission also dealt with questions relating to regional offices of the F.A.O., the establishment of the International Rice Commission and the relations between the different agencies of the U.N.O. In dealing with the programme of work the Commission first laid down certain basic principles to guide the Director-General in settling priorities among competing schemes. This was to be on the following classification: (a) Projects having world-wide effect, (b) regional projects and (c) national projects. It was emphasized that the main function of the F.A.O. was to deal with problems which exceeded national boundaries, and nothing should be done by it which might weaken the responsibilities of national governments. In the case of projects of purely national effect, the responsibility of the F.A.O. should be to give advice and technical assistance.

The Commission accepted the invitation of India to hold the Far Eastern Forestry Conference at Mysore next summer and decided that for the time being the Far Eastern Regional Conference and the Rice Council should be located at Bangkok. The question regarding the permanent site will be decided by the next session of the F.A.O. Conference.

Commission I devoted most of its attention to the current commodity situation in relation to the general objective of the F.A.O. It was recognized that the current level of world production of foodgrains and agricultural raw materials was below pre-war level and far below the level of consumption according to nutritional requirements. At the same time, because of the difficulties of foreign exchange and under-development of resources and consequent low incomes in many parts of the world, a number of exporting countries felt that current effective demand for certain products such as wheat and sugar, was below the supplies available and that the emergence of surpluses at current levels of consumption might become a reality. This point was emphasized by the leader of the Indian delegation.

On the question of development of Asia and other under-developed countries it was emphasized that the principal bottlenecks were a shortage of essential equipment and machinery and financial resources. The Commission recommended that the Director-General should invite the assistance of United Nations, the International Bank and other appropriate U.N. agencies in preparing for consideration by the F.A.O. Council, fact-finding statements concerning all financing facilities, the use being made of them and the nature of their demand. This report will be considered at the next session of the F.A.O.

Commission III dealt mainly with the location of the headquarters of the Organization, the venue of the next session and questions relating to the scale of contributions by member governments. The question of the permanent site of the F.A.O. will be decided at the Fifth Annual Conference which is to be held at Havanna early in 1951 ; pending this decision the F.A.O. will continue to remain in Washington. Questions relating to the scale of contributions and requests for reduction of contributions made by various countries, of which India is one, will be examined by a special commission to be appointed by the F.A.O. Council at its next session.

I. D. R. I. DIPLOMA

The following candidates passed the examination for the Indian Dairy Diploma Course for 1946-48 :

1. Waidyaratne R. D. P. W.
2. K. R. Bhargava.
3. M. N. Krishnaswamy.
4. Umrao Singh.
5. G. C. Joshi.
6. Indernath Sahai.
7. C. J. George.
8. G. U. K. Seneveretne.
9. Pitamber Misra.
10. M. A. Khyum.
11. Akhtar Zaman Khan.
12. Ramnath Kak.
13. Gohil M. B.
14. P. Verdarajan.
15. Kanti Prasad.
16. A. P. Pooviah.
17. Radha Krishnan.
18. A. Venugopal.
19. D. M. Doshi.
20. V. P. Tandon.
21. Channiah H.
22. G. C. Mahakul.
23. Surjit Singh.
24. Jayaram Krishna.
25. Raghunath Patnaik.
26. Ajoy Kumar Chowdhury.
27. Bhuban Mohan Hazarika.

—*(I.D.R.I.)*

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Ravine Erosion.

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Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, Government of India.

INDIAN FARMING

APRIL, 1949

Vol. X No. 4

THE FOOD PROBLEM OF INDIA*

LET me welcome you all here for the 18th meeting of the Governing Body of the Indian Council of Agricultural Research. May I in particular extend on your behalf greetings to Madhyabharat Union and Patiala and East Punjab States Union who have newly joined our Council as its constituent members and so also to Himachal Pradesh which as a Centrally Administered Area is automatically a member of the Council. I hope before long all the remaining parts of our country will be represented on our Council so that the whole of India will be participating in the important duty which our Council is expected to perform.

When I had addressed you last year I had emphasized the importance of the problem of food for our country and therefore for our Council. The Indian Council of Agricultural Research has dealings largely with research in food crops. The Council must play a vital part in solving our food problem and against the background of the realities of that problem must the Council organize and coordinate most of its work of research in the field of agriculture.

It is to help the Council to perform this function that I wish to place before it in outline the actual picture of our food situation. As you know the country was partitioned in 1947. This event has had a great effect on our economic life of which we are becoming only slowly conscious. With one stroke, our food resources were materially cut down. As a result of partition India had to maintain nearly 80 per cent of the total original population. For feeding it, however, she was left with only about 65 per cent of wheat production and about 69 per cent of rice production. In an undivided India wheat from the Punjab and wheat and rice from Sind moved to the provinces of the present India either through trade channels or governmental agency. That India was deficit in wheat and rice did not strike the mind specially when in the pre-control years rice also moved from Burma to Madras through the trade channels.

Another feature of partition which has created special difficulties in regard to food production is the disproportionate area which has become dependent on the uncertainties of monsoon. As against the share of 80 per cent of population India has been left with only 66 per cent of the original irrigated area and in regard to the wheat crop specially with only 54 per cent of the original irrigated area. The magnificent barrages and dams and extensive irrigation system which were constructed in the West Punjab and Sind at the cost of many precious crores, lie today in Pakistan to give assured supply of wheat and rice and other foodcrops for 20 per cent of the population of undivided India which has remained with Pakistan. The result of the disproportionately greater area of unirrigated land coming to us has been to subject our food production to the vagaries of monsoon to a greater extent than ever before and to render our best efforts at improved methods of agriculture through seeds and manure something of a venture. An abiding solution of our food problem is not possible unless we place the major proportion of our fields under perennial irrigation through canals or deep wells.

But while these permanent measures may be expedited, efforts have also to be made in every other possible direction to meet the immediate situation. It was with this view that in 1947 a five-year food production plan was framed in consultation with the provinces. To give you the outline of the food picture, I would place some figures before you which would enable you to know what we planned and what we have achieved.

---

* Speech delivered by Hon'ble Shri Jairamdas Daulatram, Chairman, Indian Council of Agricultural Research, while opening the proceedings of the 18th meeting of the Governing Body of the Council.

At a conference early in 1947 where the provincial Governments were represented a target of 30 lakh tons to be completed in five years was fixed for the provinces. The target planned for the first year of 1947-48 was 9 lakh additional tons over the production of 1946-47. Towards this first year's target Madras had to produce 5,29,000 tons, Bombay 57,000 tons, Central Provinces and Berar 63,000 tons, United Provinces 2,16,000 tons, Bihar 18,000 tons, Orissa 12,000 tons and Assam 9,000 tons. West Bengal and East Punjab were unable to fix a definite target due to disturbed conditions resulting from partition. This was the programme for growing more food in the year 1947-48. It was to be achieved by increased use of manure in the form of oilcakes, chemical fertilizers, compost, green manure and bonemeal and also through the distribution of improved seeds and the construction of minor irrigation works of the nature of wells, tanks and other similar small projects.

As you all know agriculture is a provincial subject and the Centre has to depend wholly upon the action taken by the provinces and States to implement any central plans for food production. The Central Government makes a small grant or loan towards this five-year programme of food production and otherwise assists through the recently started special measures for land reclamation, tube-wells and the fertilizers pool. I have no doubt that during the last year 1947-48 the provinces put forth their best efforts to complete the provincial targets but as I have explained above the vagaries of monsoon influence a larger proportion of our country than before the partition. This has affected the results of efforts in more than one province. Reports now received from all over the provinces except Orissa show that as a result of the specific schemes relating to manure, seeds and minor irrigation for which the Central Government spent only about one crore as grant or loan a total yield of nearly 7 lakh tons has been achieved as against the target of 9 lakh tons. When it is realized that the provinces could only receive one-third of their planned quota of chemical manure, cement, and steel for wells and ploughs was equally in deficit, the results achieved during the first year of food production programme are in no way discouraging specially in view of the reduced percentage of irrigated area after partition. The 'grow more food' campaign during 1947-48 has to be judged against the background of the great shortage due to the transfer by partition of vast areas of irrigated land to Pakistan.

I have given you in concrete outline the results of the special effort which the provinces put forth in 1947-48 with the aid of grant and loan of a crore of rupees from the Centre. But apart from this effort in certain parts of each province aided by the Centre, it is useful to know the achievements in the whole area of different provinces of the normal programme of cultivation. A study of the figures of total yield from the entire area within the jurisdiction of the provinces shows that Bombay, Central Provinces, and United Provinces produced between themselves in 1947-48 nearly 19½ lakh tons of foodgrains more than in the preceding year. Bombay's contribution to this additional yield was 2,27,000 tons, Central Provinces 8,96,000 tons, and the United Provinces 8,17,000 tons. These figures show the possibilities of development when the season is favourable. On the other hand the failure of monsoon in Madras which threatened famine at the end of 1947 was responsible for a deficit of more than 11 lakh tons in that province and the disturbed political and economic conditions in West Bengal and East Punjab affected the cultivation of land resulting in a deficit of nearly 3½ lakh tons in these two provinces. Assam, Bihar and Orissa also reported a total shortage of about 2½ lakh tons in comparison to the preceding year. The effect of the season on these latter regions thus wiped off a good portion of the result achieved both through the special target programme and of the favourable conditions in Bombay, the United Provinces and Central Provinces. At the end of the year 1947-48 the excess in yield over 1946-47 was reduced to 2 lakh tons. Had the monsoon not played unfair in Madras we would have a net additional yield of 19 lakh tons which is more than two-thirds of the quantity of foreign imports of food in 1948.

On our Council are represented all the

provinces and States through their Ministers and Directors of Agriculture. I find round this table many of those who are in effective authority in the sphere of food production. I may venture therefore to place a few more figures before you so that we may all know the distance which each province has to cover to ensure a sound position in regard to food. Taking figures only of last year, that is 1947-48, and after deducting 12½ per cent from the total yield of each province for seed, wastage, etc., it will be found that the *per capita* production of foodgrains in Central Provinces was 18·2 oz., Assam 15·8 oz., Orissa 15.1 oz., West Bengal 14·4 oz., United Provinces 13·5 oz., Bombay 12·8 oz., East Punjab 11·3 oz., Madras 11·0 oz. and Bihar 9·0 oz. I have not given the figures for the States because statistics of most of those areas are not completely available. The only province which could come up to what are considered as minimum nutritional needs in a country where cereals form the principal item of diet is the Central Provinces. Assam and Orissa are also near the target but the rest of the provinces have a great headway to make, and so also, I believe, many of the Indian States. The provinces have somehow to close the deficits in their food budget. The Centre cannot for long continue to make up the provincial deficits by foreign imports. A date line has to be fixed beyond which the Central Government must decline, except in a grave emergency, to assume any responsibility for supplying foodgrains to deficit regions. I think the Provincial Governments and Legislature which have to face food deficits should now consider whether their other development schemes which draw away money and men and yet are not more vital than food, may not justifiably be postponed or modified so that the topmost priority for money and men could be given to food production schemes. As it is, the needs of some provinces for dollar exchange for plant and machinery for these developmental schemes is made available only at the cost of the exchange needed for imports of food—imports which have been made necessary by the food deficits of these very provinces. I feel the problem is important and urgent enough to necessitate an almost exclusive concentration of money and men on schemes for the production of more food in the provinces and States which are chronically deficit since years or in whose cases the fitful monsoon is the main source of water supply.

I have taken a little of your time and somewhat tried your patience by giving all these dry figures so that we may have before us a concrete picture of the problem and its main feature. I know that the solution of an increase in irrigation for our food crops is not within the purview of your organization but the situation which confronts us calls for a greater effort also in the sphere which is within your jurisdiction. I have been feeling that our plan for agricultural research should be inspired by a sense of relevance and urgency in view of the serious food situation which the country has had to face as a result of partition. I would venture to suggest that our procedure may well undergo a change and on annual meetings of this nature our Council should debate the broader questions of policy related to the main functions of the Council in the context of the agricultural situation of the country. Most of the comparatively small questions which take up the time of the Council at the annual meeting could well be finally disposed of by a smaller body leaving it open to a member of the Council to raise discussion on any of the questions if he felt the need. In any case I feel it incumbent upon me to suggest to you to intensify your research in areas which are irrigated to help the increase of yields of food crops in those regions whether through high-yielding seed or pest-resistant varieties of seed or other improvements in the technique of cultivation. It is essential also, if we are to terminate soon our anxiety in regard to food production, that our food farms ought to be covered by an extensive net work of research sub-stations which should help to carry speedily to the farmer the result of successful research.

All plans of progress, however, in any field are greatly assisted by a continuous check up of the achievements of the plans from time to time. Until some years ago agricultural statistics in India were largely the result of guess work. Estimation by the eye was quite a common method. We have been slowly progressing towards accuracy. The Indian Council of Agricultural Research has made a great contribution in achieving this progress. Since 1943, the method of random sampling has been applied to estimate the yields in different provinces. The scheme of crop cutting surveys has been progressively extending and under the recommendations of the Gregory Committee and the Bengal Famine Enquiry Commission the method of random sampling is now to be applied so as to cover all principal crops in all the provinces. All this will constitute a most essential foundation on which to build our policies and programme of work in the field of agriculture. The pioneering work done by the Indian Council of Agricultural Research has drawn attention of the Food and Agriculture Organization of the United Nations which has decided to send young men from Eastern countries to learn this method of estimating crop yields at our training centre in Delhi. All the provinces have agreed to a scientific scheme of crop estimates for the coming years but it is a matter of great regret that the financial considerations have for the time being held up the necessary sanction for it. To this scheme and to the coming Agricultural Census of 1951 I attach the greatest possible importance. We will all be stumbling in the dark without the light which these two measures will throw on our path. I hope that it will somehow be possible for money being found both for the crop cutting surveys and the Agricultural Census.

An important aspect of the Council's function is the planning and coordination of agricultural research in the country. Up till now a certain system has been in practice for sanctioning schemes of research but experience has shown that in the present method there is a certain amount of waste of funds and duplication of efforts. In this connection the question of organization of research programmes on a regional basis has been engaging the Council's attention for sometime. I am glad that this problem was fully considered by the Advisory Board at its last meeting and their recommendations will now come up for your consideration. I hope the regional committee will soon start functioning and prove useful in focussing attention on problems of regional importance.

During the course of the last year the expert staff of the Council and the research reorganization committee have also reviewed all the schemes of the Council at present under operation. Each scheme was personally seen in operation by the Commissioners and Advisers and their report was considered in detail by the committee which was appointed under your instructions last year. The recommendations of the Advisory Board regarding the new schemes and extensions have been made in consonance with the recommendations of this committee. A number of general suggestions made by this committee are also before you for consideration. I should like to refer to one of these in particular, namely, the necessity for giving an opportunity to research workers to meet each other periodically, exchange ideas and profit by the experience of all workers in the field. I attach great importance to the value of such periodical meetings for the coordination and progress of agricultural research. I had recently asked the Indian Agricultural Research Institute to call a conference of agricultural research workers and I feel that this Council also should give to coordinating research their earnest consideration.

Before I close I would like to bring to your notice one of our chief difficulties in going ahead with some of our very important projects. I am referring to the policy of retrenchment more vigorously adopted by the Government of India recently, as a result of which it may not be possible for the Central Government to undertake in the very immediate future, some of the important developmental activities which should in the normal course be undertaken without delay.

I find that in a number of cases this Council expects either special funds to be provided by the Government or certain activities to be taken over and financed by them direct. Among these may be mentioned the all-India research scheme for control measures over cereal rusts, the coordinated five-year crop-cutting scheme, research work on potatoes in northern India including seed certification, all-India research on fruit including technology, and expansion of the Council's publication activities. There can be no two opinions about the necessity for undertaking these activities at the earliest possible moment but I am afraid that owing to the Government measures for enforcing strict economy in public expenditure it may not be possible for us to obtain the necessary funds required for these activities or for the Government of India to take over some of these major activities with the desired speed. However, I can assure you that I shall try my utmost to see that as many of these valuable schemes as possible are financed at the earliest possible date. I am glad to say that the Government have already agreed to take over the potato research work and the Central Potato Research Institute is expected to be in full working order from the beginning of the next financial year.

It is not my intention to take more of your time and refer to other items of the agenda. I hope we will be able to dispose of the heavy agenda before us with due expedition.

Original Articles

SOIL CONSERVATION SURVEY AND LAND USE CLASSIFICATION

By S. P. RAYCHAUDHURI

THE population of the world is fast increasing and with it there is increased demand for food, clothing and better amenities of life. Land-use planning is, therefore, assuming in every country the same importance as industrial planning. Soil conservation is intimately connected with the problem of land utilization. By soil conservation is meant the protection or maintenance of those resources on which we are dependent for permanent production. The devastating effects of soil erosion may be judged by the turbid waters of big rivers and by the accumulated sand dunes in arid and semi-arid regions. The action taken for checking soil erosion in the United States of America consists in first carrying out survey for Basic Land Resource Areas, then Soil Erosion Survey followed by Soil Conservation Survey and Land Use Classification which enables ultimately the preparation of Farm Plans.

Basic Land Resource Areas

The rate of soil decline determined on the basis of the present condition of the soil resources of the country, is very important for planning soil conservation measures. To differentiate between soil decline due to the action of natural forces and that due to man's use and occupation, the country is first to be delineated into basic land resource areas. These are areas having differences in the land due to the dynamic effects of physiography, climate and soil. The factors influencing the development of the inherent characteristics of the soil are climate, topography, vegetation, parent material and age. Land areas are first broken down into major basic land resource areas on the basis of inherent characteristics of soil, prevailing climatic environment and micro-topography, which are further broken down into minor basic land resource areas on the basis of differences in climate, soils and topography. Such delineations are done by superimposing the different maps on one another. The minor basic land resource areas are further broken down into unit areas based on differences in the physical land features, due both to the action of natural forces as well as to man's use.

The relative rate of soil decline is represented by the length of time the productive power of an area of soil is capable of producing at the present rate, under the present management. Where accelerated water erosion is the chief factor of deterioration, the rate of soil decline may be computed by dividing the inches of top soil which, if lost, would reduce the land to the next lower capability class, by the average annual loss. Similarly in areas subject to wind erosion, for both soil removal and detrimental accumulation by blowing, the number of inches of soil required to reduce the land to the next lower capability class can be divided by the average annual rate of soil lost or deposited by blowing over a period of years, to obtain the figure for the rate of soil decline.

Soil erosion survey

Once the major, minor and unit basic land resource areas have been delineated, soil survey of one to two per cent of the basic land resource area is then carried out in detail and the data worked out for the entire basic land resource areas, which gives soil erosion survey data of the different states. These soil erosion survey

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data are useful for Project Planning or Preliminary Planning which precedes soil conservation survey.

Soil conservation survey

Soil conservation survey is an inventory of certain physical conditions which are of importance in the proper use of land. These are texture of surface soil; permeability of subsoil and substratum; effective depth; depth and nature of underlying geologic materials which affect the depth of soil or may interfere with conservation practices; depth to water table; alkali and salts; fertility; slope and nature of terrain; overflow hazards; kind and intensity of erosion as well as the present use of land. These factors are simplified into a general classification which shows the potentiality for use. The primary purposes of soil conservation survey are:

(a) Planning of individual farms.

(b) Overall inventory of the land resources.

(c) A basis of determining the extent of the job of soil conservation and proper land use and to find out what is needed by way of equipments and costs.

The principal units for mapping soil delineations are as follows*:

(1) *Effective depth of soil*

(i) Deep	36 in. or more
(ii) Moderately deep	20 in. to 36 in.
(iii) Shallow	10 in. to 20 in.
(iv) Very shallow	Less than 10 in.

Effective depth refers to the depth of material to which plant roots can penetrate readily, and which supplies water and plant nutrients.

(2) *Texture of surface soil*

(1) Very heavy	Heavy clay, 60 per cent or more 2 micron clay.
(2) Heavy	Clay, silty clay, sandy clay.
(3) Moderately heavy	Silty clay, loam, clay loam, sandy clay loam.
(4) Medium	Silt loam, loam, very fine sandy loam.
(5) Moderately light	Fine sandy loam, sandy loam.
(6) Light	Loamy fine sand, loamy sand.
(7) Very light	Sand, coarse sand.

(3) *Permeability*

	Rate in inches of water head per hour through separated undisturbed core under gravity with ½ in. water head.
(i) Very slow	less than ·05
(ii) Slow	0·05 to 0·20
(iii) Moderately slow	0·20 to 0·80
(iv) Moderate	0·80 to 2·50
(v) Moderately rapid	2·50 to 5·00
(vi) Rapid	5·00 to 10·00
(vii) Very rapid	More than 10·00

(4) *Degree of available moisture capacity*

	Available moisture capacity in inches of water per 60 in. soil depth—tentative.
Very high	12 in. or more
High	9 in. to 12 in.
Moderately high	6 in. to 9 in.
Low	4 in. to 6 in.
Very low	Less than 4 in.

(5) *Reaction*

Acid	6·5 *p*H or less
Neutral	6·6-7·3 *p*H
Alkaline	7·4 *p*H or higher

(6) *Moisture conditions as indicated by colour profile*

(i) Mottled or gray colours in the soil profile indicate development under restricted or poor aeration caused by presence of water.

(ii) Bright colours and absence of mottling indicate good aeration.

The following drainage profiles may be recognized according to increased portions of mottled or gray colours in the soil profile:

Well-drained
Moderately well-drained
Imperfectly drained
Poorly drained
Very poorly drained

Swamp or marsh—peat and muck are formed in wet places where conditions are right for accumulation of plant remains.

(7) *Inherent fertility*

Inherent fertility or nutrient level is very difficult to evaluate on a national scale. It is recommended to use that factor as a mapping criterion only when necessary to separate mapping units that are alike with respect to other properties.

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* *Guide for Soil Conservation Surveys*, United States Department of Agriculture, December, 1947.

Usually four degrees of inherent fertility are sufficient :

High
Moderate
Low
Very low

(8) *Organic content*

The organic content of a soil usually is an index to its durability and productive capacity, and like inherent fertility, should be used only to differentiate mapping units that are otherwise similar. Usually the following broad classes will suffice : High, medium and low.

(9) *Underlying parent material*

Parent material may be a clue to understanding soil deficiencies such as lack of copper or manganese and the presence of toxic elements such as selenium.

(10) *Degree of erosion*

For determining the degree of erosion in a certain region the normal profile is fixed up in forest areas or grass lands which have not been under cultivation and then by comparison of depths of horizons, the degree of erosion of soils in other areas fixed up.

The following degrees of water erosion may be differentiated :

None or slight	Less than 25 per cent of top soil lost.
Moderate ...	25 per cent to 75 per cent of top soil lost.
Severe ...	75 per cent or more of top soil lost.
Very severe...	All top soil and more than 75 per cent of subsoil lost.

(11) *Slope*

Slope classification depends on the nature of soil. The general classification is given below.

A	... ...	0 to 3 per cent
B	... ...	3 to 8 per cent
C	... ...	8 to 15 per cent
D	... ...	15 to 25 per cent
E	... ...	25 per cent and over

or

Nearly level
Gently sloping
Moderately sloping
Strongly sloping
Steep
Very steep

(12) *Wetness*

Free water within the effective depth of soil during the growing season interferes with the growth of crops. Wetness or presence of free water that persists long enough to be a significant land factor may often be corrected by artificial drainage. To determine drainage needs, degree of wetness is considered in relation to the requirements of the crop and of the cropping system.

The following degrees of wetness meet most farm planning needs :

Slightly wet : Adopted crops may be slightly affected or planting dates slightly delayed.
Moderately wet : Adopted crop may be moderately affected or planting dates moderately delayed.
Very wet : Adopted crops seriously affected.
Permanently wet : Swamp or marsh.

(13) *Salinity*

Presence of soluble salts is a serious limiting factor in land use. The following separations have been suggested :

Slight salinity: Crop yields slightly affected or range in kind of crops slightly limited.
Moderate Salinity : Crop yields moderately affected or range in kind of crops moderately limited.
Severe salinity: Crop yields seriously affected or range in kind of crops seriously limited.
Very severe salinity : Growth of useful vegetation prohibited.

The above definitions may be made more precise with statements about local crops and conditions.

(14) *Frequency of overflow*

Overflow hazards often influence the use and management of the land, and a knowledge of the frequency and duration of overflow is desirable. The three separations listed below are generally sufficient for farm planning :

(i) Occasional overflows or overflows of short duration: Crops occasionally damaged or planting dates somewhat delayed.

(ii) Frequent damaging overflows or overflows of long duration : Crops frequently damaged or kind of crops severely limited.

(iii) Very frequent damaging overflows or overflows of very long duration : Not feasible to grow cultivated crops. More precise definitions for local conditions including time of flooding may be given.

Land use classification

Land capability may be defined as the inherent ability of the land to produce permanently under specified uses and treatments. This classification depends on the soil conservation survey and on the potential use and capability of the land. Eight classes of lands are used throughout the United States which show in a general way the lands suited for cultivation and for other uses with approximate degrees of limitations in such use that are required by the natural properties of the land, consistent with the general ideas and economics of the land. Those lands suited for cultivation are placed in classes I, II, III and IV, each of which represents a varying degree of suitability for safe long time cultivation. The lands which are not suitable for cultivation but suited for pasture or woodlands are classified as V, VI and VII, while land suited for wild life or recreation only is classified as VIII. Soil units separated one from another by solid black lines on the land use capability map are coloured a predominant basic colour of green (class I), yellow (class II), red (class III), blue (class IV), green (class V), orange (class VI), brown (class VII) and purple (class VIII).

As in any classification several categories are established each at a different degree of generalization.

The different categories of the present land use classification in the United States are shown in Table I.

(i) The most general sub-division is the separation of *land suitable and not suitable for cultivation.*

(ii) The next sub-division is according to the degree of limitations and differentiates the *eight land capability classes*. The separations in this category are suitable for overall considerations of suitability for cultivations or other uses, but usually not for specific recommendations of uses, or erosion control or other treatments on crop lands, range, pasture or forest.

(iii) The third sub-division often called *land capability sub-classes or treatment groups* is based on the kind of limitations. Treatment groups are related with major types of management or corrective measures needed. Often the sub-classes or treatment groups reflect the local soil moisture supply.

(iv) The fourth sub-division, usually called *land treatment units (or use management groups)*, primarily according to kind of soil and other side factors, is usually necessary before specific recommendation for land management and conservation can be made.

Farm planning

After the land use classification map has been prepared the next step in soil conservation is to work out with the farmer in the fields a farm plan or blue print for practical operations together with adoptable conservation practices and measures, with a view to use every unit parcel of farm land to its maximum use capability. All these jobs of soil conservation ultimately lead to a new arrangement of fields, pastures, meadows, woods, wild life plantings and water disposal systems that safeguard the soil.

It may be mentioned here that some work on these lines is being carried out in Bombay by the Land Improvement Section of the Department of Agriculture. But the achievements cover only small areas and are not commensurate with the magnitude of the problem of the country as a whole. It is hoped that such work on coordinated and wide scale basis will be taken up as early as possible.

TABLE I

Outline of the land-capability classification in the U.S.A.

	Land capability classes	Treatment groups	Treatment units
Major land use suitability	Differentiated according to physical properties of the land; set up in relation to degree of limitations; correlated generally with intensity of treatment needed to protect the land and use it safely.	Separated on basis of kind of limitations; correlated with major types of management or correction needed.	Separations within a land-capability class or treatment group on basis of soil primarily.
Suited for cultivation	I Very good land; few or no limitations; can be cultivated safely with ordinary good farming methods		Deep, well-drained, medium-textured productive bottom-land
			Deep, well-drained, acid, sandy loam soils on nearly level upland
	II Good land; moderate limitations or hazards; can be cultivated safely with simple easily applied or moderate conservation practices	II-A Gentle slopes requiring erosion control	Deep, heavy-textured soils on gentle slopes
			Deep, medium-textured, very fertile soils on gentle slopes
		II-B Flat wet land requiring drainage	Deep, medium-textured, moderately permeable, fertile soils; flat
	III Moderately good land; severe limitations or hazards; can be cultivated safely with intensive treatments	III-A Moderate slopes requiring erosion control	Medium deep, medium-textured, moderately permeable soils; moderate slopes; moderately eroded
			Deep, heavy, slowly permeable, neutral soils; moderate slopes
			Medium-textured soils with clay-pan
		III-B Wet land requiring drainage	Deep, heavy-textured, dark coloured, poorly drained soils; flat land
		III-C Alkali problem requires diking and flooding	Deep, heavy-textured, slowly permeable soils; moderate high content of alkali salts
		III-D Low water-holding capacity and inherent fertility	Deep sandy soils; rapidly permeable; low in fertility
	IV Fairly good land; very severe limitations or hazards; suited for some forms of limited cultivation or for limited choice of crops	IV-A Moderately steep slopes requiring erosion control	Shallow, medium-textured soils
			Deep, medium-textured soils
		IV-B Wet land	Deep, medium-textured soils
		IV-C Flooding hazard	Deep, medium-textured soils

	Land capability classes	Treatment groups	Treatment units
Not suited for cultivation but suited for grazing or forestry	V Not more than slight limitations, except those imported by the needs of desirable grass or tree vegetation		Nearly level, wet mountain meadows
			Well-drained, nearly level, deep soils but too stony for cultivation
	VI Moderate limitations	VI-A Erosion control	Deep, medium-textured soils on steep slopes
			Shallow, gravelly soils on moderate slopes
		VI-B Flat wet land requiring drainage	Deep, heavy soils requiring drainage
	VII Severe limitations	Erosion control	Very shallow clay soils on very steep slopes
			Very shallow sandy soils on very steep slopes
Not suited for cultivation, grazing or forestry	VIII Very severe limitations ; suited only for wild life or recreational use or for watershed protection purpose	VIII-A Wet land	Coastal saline marshes
			Inland fresh water marshes
		VIII-B Rough rock and /or rocky areas	High mountain areas
			Rough odd areas
		VIII-C Sands	Coastal beach

VEGETABLE AND FLOWER SHOWS : SUGGESTED STANDARDS FOR EXHIBITS AND JUDGING

By B. K. DAS

SHOWS are admittedly the best methods of propaganda, whether they are for livestock, vegetable, flower or any other industry. In organizing vegetable and flower shows, however, prefixing of some minimum standard is necessary in respect of the quality and quantity of exhibits and for judging, so that arrangement of the exhibits in the shows may be more methodical, judging may be easier and more perfect, and both the exhibitors and the public may gradually become versed in the essential and finer points of the vegetables and flowers.

The average Indian producer has a tendency of sacrificing quality for size or number and the average buyer quality for cheapness, both losing ultimately, the former by getting less price for their produce, the latter by getting less value for their money. Shows, when well-organized, should prove to be excellent mediums for rectifying these errors through the enforcement of an adequately high standard for the entries and for the award of prizes.

Standard of exhibits

In fixing these standards, the main principle should be that quality in the exhibits should always take precedence over size when the latter is achieved at the expense of the former.

Quality in vegetable means (1) optimum suitability for the table, which entails that it should be fresh, mature but tender, palatable and free from disease,

and (2) even shape and pleasing exterior, which indicates care in cultivation and subsequent handling of the crop.

Quality in flower means :

(1) Freshness.

(2) Maximum development without becoming over mature.

(3) Freedom from blemish, denoting clean cultivation.

(4) Rich colour and smooth texture of petals, showing the effect of proper manuring, spacing and utilization of sun light.

(5) Length and strength of flower stem and greater number of flowers in the same stem, showing vigorous growth of the parent plant which has resulted directly from proper system of cultivation and manuring.

Number of exhibits in the same class

It is advisable to fix up a definite number for each class, so that overcrowding of the available space in the shows may be avoided, and judging may be easier through effective comparison between equal number of exhibits.

These numbers should be strictly enforced ; any more or any less should normally disqualify the exhibit. Suitable numbers for some of the important winter season vegetables and flowers are suggested in Table I in this connection. These have been found to work satisfactorily for the past several years in the case of amateur exhibitors from a population of 30,000 people in Digboi, Upper Assam. On the face of it, some of these numbers may appear to be small and inadequate, but in actual practice, it is surprisingly difficult for many exhibitors to get together even this number of uniformly good specimens of any one class.

Preparation of the exhibits for the show

In this case too, for the sake of facilitating comparison and judging and to give a clean and balanced appearance to the show, some definite rules should be laid down. These are also suggested in Table I.

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TABLE I

Preparation of flowers and vegetables suitable for exhibition

Vegetables	Required number	Conditions regarding preparation for show
French bean, Dwarf or Climbing, peas and *sheem* or Indian bean	12 pods	Stringed side by side on leaf or card board
Beetroot, carrot, turnip and Indian radish	8	Leaf stems shortened to 2 in. and with tap root
Brinjal	8	With fruit stem
Cabbage, all varieties and cauliflower	3	Without roots and with only four outside leaves around the head or heart
Gourd	3	With fruit stem
Knolkhol	8	Without roots and with leaf stems shortened to 2 in.
Lettuce, Cos or cabbage	3	Whole plant without roots
Onion	12	Unwashed with roots but without tops
Potatoes		Unwashed
Tomatoes	12	Complete with fruit stem

Flowers	Required number	Conditions regarding preparation for show
Antirrhinum and Larkspur	6 spikes	In vases or hollow bamboo receptacles, with a little water inside
Calendula, Dianthus, Pansy, Phlox and Verbena	6 flower stems	,, ,,
Carnation, Cosmos, Dahlia, Gerbera, Marigold and Poppy	6 blooms	,, ,,
Nasturtium	6 blooms	In a posy with their own foliage
Sweet Pea	4 vases	Mixed or single colour 6 flower stems per vase

Judging

The success of the show from the educative point of view rests entirely on the correct judging of the exhibits. Judges should therefore be selected from experienced and largescale growers of vegetables and flowers, preferably belonging to the same district where the show is held or at least possessing intimate knowledge of the soil and climate of the locality. Without such knowledge it may be difficult for them to appreciate the results achieved by the growers or to make allowance for the vagaries of nature.

(1) Judges should search for both merits and faults in the exhibits. Specimens possessing the least number of faults win the prizes.

(2) All exhibits should be perfectly clean, fresh and free from blemish of any kind.

(3) The samples composing an exhibit should be all of even size and quality, and of one variety only. Mixing good and bad, or large and small specimens together weakens the exhibit and reflects on the capabilities of the exhibitor.

(4) Quality, meaning optimum suitability for table use, coupled with suitable size is of paramount importance in vegetables. Size achieved by sacrificing tenderness and palatability is a defect. On the other hand, any specimen too small to be economically useful, though perfect in other respects, is also defective.

(5) Large size of blooms, possessing rich colour and texture are points to look for in flowers. Length and strength of flower stems, and number of flowers in the same stem, in some cases, also count at the time of judging.

(6) When a particular class of exhibit does not satisfy the minimum standard of quality, no award should be given. However, for the sake of inducing greater endeavour in the future, a consolation prize may be offered to the best exhibit of this lot.

Judging of individual vegetables

(1) *French Bean :*

Points to look for: Tenderness; shape—smooth and even.

Test: When broken into two the pods, if fresh and tender, should break clean with a crisp noise and no sign of strings should be evident in the sides. The seeds should be in half-formed stage with milk inside and the space between the seeds should be fleshy and succulent, and the shape of the pod should be smooth and even.

Immature pods will have a thin undeveloped body with seeds just beginning to form. Pods, when over mature, will be distinctly uneven in shape caused by the swelling of the seeds.

(2) *Beetroot :*

Points to look for : Tenderness ; even shape ; and taproot.

Test for tenderness : In tender roots, the inside when cut open should be compact, the cut surface should have a moist appearance and even crimson colour, and there should be no appreciable sign of whitish lines of sponginess which indicate over maturity. Over mature beets do not form fibres like knolkhol, radish, etc. but become light and spongy as maturity progresses.

Even shape of roots indicate well-prepared soil which promotes uniform all round development.

Single, straight and long taproots indicate deep and fine tilth of soil. Twisted, bifurcated or cankered taproots indicate hard and unclean soil conditions.

(3) *Brinjal :*

Points to look for : Tenderness ; glossy colour and smooth surface.

Test for tenderness : Tender fruits should feel soft when pressed by fingers and should have a glossy colour. When cut open, the seeds should be just forming and white in colour. Brownish seeds, greying surface colour and a hard body are signs of over maturity. Absence of fruit stem and wrinkled surface are signs of staleness.

4) *Cabbage :*

Points to look for : Tenderness; compactness of heart.

Test for tenderness : The top leaves, in tender heads, should be unbroken, nicely overlap one another and be of pleasant green colour. Whitish colour, opening up of top leaves and marked conical shape in the case of ballhead and drumhead cabbages usually indicate over maturity.

Test for compactness : When pressed with hand the top as well as the sides of the heart should be hard and non-yielding throughout, and when tapped with finger, should give back a hard sound. When lifted it should be quite heavy for its size. When opened lengthwise, a compact heart should have very close formation of leafy layers from top to bottom. Immature heads will have a soft, flabby and light body.

(5) *Carrot :*

Points to look for : Tenderness ; even shape ; taproot.

Test : Same as beetroot with these additions :

(i) Tender roots should be quite sweet to taste when chewed raw, and

(ii) when cut open, over-mature roots should show a cylindrical fibrous core, with a greenish tinge in the advanced stage.

(6) *Cauliflower :*

Points to look for : Compact and well-blanched head.

Test for compactness : A compact head should have a solid, homogeneous formation with a markedly convex shape and should be quite heavy for its size. Swollen, uneven surface, loose and open build are defective.

Brownish or scorched colour of the head is also a defect as it detracts from both appearance and palatability. It is caused by either disease or too much exposure to sun light.

(7) *Gourd :*

Points to look for : Tenderness.

Test : Dull knife or finger nail when pressed lightly on the body, specially on the neck, should cut in very easily. When opened the seeds should be just forming and the cut surface should exude moisture. The process of cutting itself should further be effortless.

(8) *Knolkhol :*

Points to look for : Tenderness ; colour—glossy and green.

Test for tenderness : When cut open the inside should be crisp and compact, with total absence of sponginess. Colour should be pleasantly green and glossy.

When over mature the surface will have a dry greyish appearance and the skin and adjacent pulp will become fibrous to a greater or lesser extent.

(9) *Lettuce, cabbage or cos :*

Points to look for : Well-formed heart ; crispness and tenderness.

Test : Same as cabbage, except that the heart of lettuces is always less compact than that of cabbage, specially so in the case of cos lettuce.

All outer leaves of cabbage lettuce should be tender, crisp and suitable for table use. Cos lettuce is coarser than cabbage lettuce, but is considered to be more crisp by some people. The extreme outer leaves of cos lettuce are rather too coarse for table.

(10) *Onion :*

Points to look for : Smooth and round shape of bulb ; unbroken outer skin and glossy colour.

Smooth and round shape indicate loose tilth of soil. Unbroken outer skin shows maturity of the bulb and proper handling after harvesting. Glossiness of colour shows freshness and proper cultivation.

Presence of well-developed root system indicates well-cultivated soil.

(11) *Peas :*

Points to look for : Tenderness ; sweetness, evenness and number of seeds in the pods.

Test for tenderness : Tender pods should be well-filled but not over-blown. The colour of the pod should be deep green and the outer skin should be free from wrinkles. When opened up, the seeds should be green in colour, well-developed, free from coarseness or wrinkles and be quite sweet to taste.

Number of seeds in a pod should be at least eight or more (the more the better, for winning a award) and should be closely arranged with little or no space in between. Immature pods will have a somewhat flat body with seeds half-formed and set well apart. Over-mature pods will have a inflated body with the edges depressed and the seeds inside will be tougher and less sweet to taste.

(12) *Potato :*

Points to look for : Large and regular size ; smooth, even and clean shape with shallow eyes ; colour whitish and skin unbroken ; tubers fully mature.

Irregular shape and dented surface denote lumpy or unpulverized soil. Spotted or scaly surface shows presence of disease or results of improper manuring. Peeling off of skin and soft whitish pulp show premature harvesting. Dark skin also shows premature harvesting and subsequent storing, or harvesting during rains. Green surface shows exposure of the tubers to sun light during growth. Deep set eyes, which detracts from utility, is a defect, but is usually a varietal drawback.

Tubers should be unwashed at the time of exhibiting, so as to prevent the exhibitor from removing the surface defects, if any, of the tubers.

(13) *Radish—Indian :*

Points to look for : Tenderness ; smooth, straight, even and clean body ; sweetness and taproot.

Test for tenderness : When bent the body of the root should be flexible. When broken, the parts should come apart easily with a crisp noise, and the inside should be compact without any sign of sponginess in the centre or of net-work of fibres below the skin. The flesh should also have a succulent appearance.

Smooth, straight and even surface indicate fine tilth of soil. Crooked structure, rough, scaly and discoloured surface indicate lumpy soil and faulty application of manure.

Discolouration of pulp is a sign of disease or application of raw cow-dung. Single, straight and long taproots indicate deep cultivation of soil. Sweetness of the roots when tasted raw indicate proper manuring and utilization of sun light and is one of the main points of consideration at the time of judging.

(14) Sheem *or Indian bean :*

Points to look for : Tenderness.

Test : Same as French bean, except that the space between seeds inside the pod is rather empty compared to the fleshy counterpart of French bean, and the pods are more susceptible to infestation by insects.

(15) *Tomatoes :*

Points to look for: Shape—round and smooth and well-filled ; body—ripe but firm with green fruit stem. Colour—deep and even ; seeds less in number.

Deeply corrugated shape repels custom and often indicates weakness of the parent plants. Flabby body shows premature harvesting and rough handling. Variegated colouring shows uneven ripening, or uneven exposure to sun light, or insect bite. Light or greenish colour shows premature harvesting. Absence of fruit stem (which smells like mint in fresh fruits when pressed between fingers), and wrinkled surface are contra-indications of freshness.

Greater number of seeds make the fruits less palatable and detracts from utility.

(16) *Turnip :*

Points to look for : Smooth and even shape ; tenderness and taproot. Colour—clean and glossy.

Test: Same as beetroot. Colour turning grey or unclean is a sign of over-maturity or staleness.

Judging of individual flowers

(1) *Antirrhinum :*

Tall varieties are more showy for table decoration than intermediate or dwarf varieties.

Points of merit : Flower spikes 18 in. or more in length, with proportionate thickness ; flowers mostly in full bloom and arranged from top to bottom of the spikes.

(2) *Calendula :*

Points of merit : Large double blooms with straight or drooping petals supported by long and stout stems.

(3) *Carnation :*

The early flowering, scented varieties are more easily grown and are more in demand for table decoration.

Points of merit : Fringed double flowers delicately scented.

(4) *Cosmos :*

Double or crested varieties are more showy than the common single variety ; large double blooms on long and strong stems.

(5) *Dahlia :*

The many varieties of this flower may be broadly grouped into three main varieties, the single, the decorative, and the cactus.

Points of merit : Big flowers (which easily attain a diameter of 6 in. or more under proper care), with rich warm colour and supported by long, strong stems which extend well above the foliage.

(6) *Dianthus Heddewigii :*

This flower also may be grouped into single and double classes. In single flowers, the fringed varieties are excellent for table decoration. Rich colour with prominent contrasting colouring of the eyes deserves merit.

(7) *Gerbera :*

This flower is unsurpassed for elegance, and beauty, both for the garden and table decoration.

Points of merit : Big flowers (3 in. or more in diameter) of scarlet, crimson or pink colours, supported by stems which are 18 in. or more in length.

(8) *Larkspur :*

Points of merit : 18 in. long or bigger spikes with massive arrangement of flowers in full bloom. Colouring delicate.

(9) *Marigold :*

Points of merit : Double giant varieties attaining a diameter of 3 in. or more with proportionate depth and denseness of petals.

(10) *Nasturtium :*

Double gleam scented varieties are more in demand for table decoration.

Points of merit : Posy should be with their own foliage for the sake of beauty and contrast. Flowers should stand clear above the foliage. Foliage obscuring the flowers is a defect in nasturtiums.

(11) *Pansy :*

Large flowers with conspicuous colouring in the centre are praiseworthy.

(12) *Phlox :*

The grandiflora type is more popular than the dwarf.

Points of merit : Massy inflorescence, flowers with clear body (i.e. without eyes) and with delicate colouring.

(13) *Poppy :*

Both single and double varieties are grown.

The flowers of the single variety possess greater delicacy of structure and are richer and more varied in colouring. Flowers in full bloom, with rich and uniform colouring are preferred.

(14) *Sweet peas :*

As individual quality of this flower counts at the time of judging, bunches need to be displayed accordingly.

Points of merit : Stems long and stout carrying three or more flowers ; flowers large and frilled and free from spotting or scorching.

(15) *Verbena :*

Densed heads of finely shaped flowers with bright colour are meritorious.

TACKLING THE FOOD PROBLEM*

By B. P. PAL

MAN is still basically dependent on plants for subsistence. For plants are the sole creators of food and clothing materials; man and other animals are merely cultivators, transformers, processors or purveyors. When we consider the manifold other uses of plants and plant products including their service in building and conserving soil, in controlling floods and erosion and in increasing the aesthetic enjoyment of life, we can assert, without fear of contradiction, that botany—which is the science dealing with plant life—holds the foremost place among the sciences. Botanical science can bestow upon man better varieties of crop plants and can show the best methods of protecting them against diseases and other hazards.

Since the beginning of civilization man has had a direct and vital interest in his food supply. But today that interest presents itself before us in the form of an acute problem—the problem of food. It is well-known that the bulk of our population lives on the margin of subsistence. This population is increasing at an appalling speed; about 5 million people are added every year to the present population of 400 million. Our problem is how to raise more food and better food for them all. The botanical sciences, with the rapid progress they are making and profiting by advances in other related sciences, can solve this problem.

Some of the important applications of botanical research for increasing crop production and solving the problem of food are described below.

Plant breeding

Although there are several scientific methods of increasing the returns from the land, there is only one which makes no demands on the purse, or the skill, or the intelligence of the cultivator. The method is plant breeding. It is therefore the method which must have the widest possible application in India. The plant breeder's preliminary methods today are the same as those traditionally used by man; he uses the method of simple selection and sorts out the best from the mixture of varieties grown by the farmer. After this first sorting out, further progress is possible by the method of hybridization or crossing by which desirable characters, like yield, quality and resistance to diseases and pests, situated in the different plant varieties are sought to be incorporated into a single improved variety. Already, in India, a large number of improved strains giving higher yield and better quality produce have been evolved in a wide variety of crop plants such as, wheat, rice, sugarcane and others. Many of these varieties are being grown with great success by the cultivators over a large area and there is much scope for the extension of the area under improved crops which would result in a significant increase in the agricultural production of this country. The plant breeder has not only selected the best variety from a mixture of existing varieties, he has also created new ones by the application of discoveries in sister sciences like genetics, cytology and physiology to crop production. The modern plant breeder is a highly trained technician; he can now re-mould the heredity of plants by using drugs and X-rays and other devices, he can make plants larger or smaller, quicker or slower growing, annual or perennial; he can also by suitable chemical treatment, make sterile hybrids fertile.

Hybrid vigour

Besides the production of improved varieties with the desired combinations of useful characters, another significant way in which hybridization has been of value in crop improvement is in the utilization of the phenomenon of hybrid vigour. It has been realized that when two varieties are crossed, the hybrids raised from the crossed seed are usually more vigorous

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* A talk from All-India Radio, New Delhi, in the series: 'Science the New Prometheus: Tackling the Food Problem'. Published with the kind permission of the Station Director, All-India Radio, New Delhi.

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and hardier than either parents. The mule is a familiar example of this vigour and hardiness of hybrids. Successful use has been made of this phenomenon in increasing crop yields. In America, by hybridizing suitable varieties and distributing the hybrid seeds to the cultivators, 20 to 35 per cent increases in acre yields of maize have been obtained.

Besides maize, there are several other crops, such as tomatoes, brinjals, etc. where because of the facility with which crossed seeds can be produced, the agricultural utilization of hybrid vigour is possible. At the Indian Agricultural Research Institute, New Delhi, one particular hybrid of brinjal, Pusa Purple, has proved very superior in points of yield and quality to the other varieties and hybrid seeds of this particular combination are being distributed for cultivation.

Vernalization

A remarkable development in the field of plant physiology in recent years, which is of considerable significance to breeding, is the theory of vernalization developed by the Russian scientist, Lysenko. It has been shown by him that through vernalization the time of flowering and therefore of fruiting and seed setting can be predetermined by appropriate treatment of the germinating seeds. Plants have their own particular requirements with regard to temperature and light and if these conditions are provided in advance to the germinating seeds in appropriate amounts, they can pass on to the flowering stage much earlier than if the seeds were not so pre-treated. Thus, certain varieties of wheat when sown in spring were found to grow well and tiller profusely but they failed to flower and set seed. After vernalization, seeds of the same variety gave crops which proceeded to ear normally and ripened before the onset of winter. The advantage of vernalization has been made use of chiefly in Russia. In the frozen north of Russia, short summers sandwiched between long icy winters made wheat cultivation impossible until vernalization, by shortening the period between sowing and harvest, made these areas productive. This marked a great triumph over Nature's climatic barriers to agricultural production. Vernalization is also of great value in speeding up of plant breeding. It is now possible to adjust the time of flowering of varieties for breeding work. Vernalization also facilitates the rapid multiplication of desirable strains by making it possible to grow two or more generations in a year.

Photoperiodism

Another factor which is now known to influence flowering and seed formation in plants is photoperiod or duration of sunshine. Plants can be divided into groups according to the daily length of illumination of sunshine which they require for flowering. The 'long-day' plants need more than twelve hours of light for successful flowering and the 'short-day' plants will flower only if they receive less than twelve hours of light per day. There are also 'neutral' plants which are indifferent to long or short days. Advantage has been taken of this response of plants to light in experiments for breeding better varieties of crops. In America, the breeders grew to maturity three successive generations of wheat in one year by using artificial light to supplement natural day-light. Russian workers, by subjecting different varieties of cotton to artificial illumination, synchronized the flowering of widely divergent varieties and species and thus obtained hybrids between them, where under normal conditions it would have been impossible to do so because of the difference in their flowering seasons. South American varieties and species of potato possessing very valuable characters of disease and drought-resistance and which would ordinarily not flower under Indian conditions have been made to do so at Simla by subjecting them to artificial conditions of illumination and have been utilized for breeding disease-resistant varieties of potato.

Hormones

Closely associated with the study of the experimental control of the time of flowering of plants, is the study of chemical control of growth and development in plants by chemical substances known as hormones. Plant hormones are not to be regarded as mere stimulants to plant growth; no growth can take place in the absence of plant hormones and in fact they are the regulators of plant growth. Their chief applications have been in horticultural practice, particularly in stimulating root formation in cuttings, which are otherwise slow to root, in preventing premature fruit drop, particularly in apples and citrus, and in producing seedless fruits. Since hormones in exceedingly small quantities regulate growth, an overdose of these can also bring about irregular and unbalanced growth and even death and this principle is now utilized in controlling weeds among lawns and agricultural crops. In fact, there are several seed-supplying firms and nurseries abroad which nowadays supply these hormone sprays for the purposes indicated above.

Colchicine

Still another chemical which has been successfully used in crop improvement is the drug, colchicine, used in medicine as a specific for gout. Colchicine, when administered in weak solutions in water to actively growing parts of plants, causes doubling of the hereditary material in plants. Such doubling results in an increase in the size and vigour of the plants and its various organs; thus the leaves, the flowers, the fruits and the seeds become bigger in size. Bigger size of fruits and seeds would mean increased yield. In this way, not only has the yield in certain crops like sesamum and buckwheat been increased by 40 to 56 per cent, but in some crops a change in quality has also been effected; thus tomatoes with twice as much vitamin C content and maize with 43 per cent increased vitamin A activity have been produced.

Hydroponics

And this is not all. So far an account of attempts to grow two blades of grass where before there grew but one has been given. Here is an interesting achievement whereby remarkable crops like lettuce, tomatoes, cucumbers and radishes were grown on a desert island ordinarily capable of growing none of them. It was on a desert island, the Ascension, one of the remoter islands of the South Atlantic. The explanation of how it all was done is 'hydroponics'. This island has no soil; it is still only a heap of volcanic cinders and jagged rocks set in the middle of an ocean. There a thousand Servicemen have been getting all the fresh vegetables and salads they need for a balanced diet.

Hydroponics is the art of growing plants not in the soil but in water in which chemical nutrients are dissolved. Besides the novelty of the principle of growing crops without soil, some of the results obtained by this method are astounding, the yields being far superior to those obtained from the richest farm lands. The Americans have raised crops of as much as 200 tons of tomatoes to the acre, in exceptional cases, entirely without soil. It must be stressed however that such yields cannot be regularly or economically obtained. There is a wide variety of methods and one of the best is probably the one in which plants are grown in a bed of sand or shingle to which chemical nutrient solution is added at intervals. The choice of a chemical nutrient varies according to the chemical composition of the water used.

While hydroponics cannot be expected to solve the food problem of a country its usefulness under special conditions cannot be lightly disregarded.

The price of a sound, comprehensive national life in these times is widespread and intelligent scientific research. Botanical research, which is so vital in tackling important problems like those of food and clothing, certainly has a very important part to play in the future development of our country.

METHODS OF RAT-CONTROL IN FOODGRAIN GODOWNS

By MOHAN SINGH

RATS are one of the chief enemies of foodgrain. They begin their depredations right from the time the grain is on the threshing yard and continue till it is ultimately consumed. Unlike insects, rats spoil more grain than they actually eat. They enter the store at night, gnat at bags, spill the grain and carry some of it back into their burrow. Except for small, shiny droppings and foot and tail marks, they leave behind no other clue about their presence in stores. It is, therefore, little wonder that the control of rats infesting foodgrain godowns has not received the attention it deserves. There is no accurate estimation of the annual loss of grain in India through rats but a rough and a very conservative estimate places it at about one million tons. The methods of rat-control peculiar to the grain godown described in the following pages will go a long way to minimize the loss of foodgrain due to rats.

Species of rat

There are more than one species of rats that may infest foodgrain godowns but two species popularly known as the 'Brown' (*Rattus norvegiens*) and the 'Black' (*Rattus rattus*) rats are mainly responsible for the damage in the stores. Both of these species are found throughout India. The brown rat is of a heavy build and has small thick ears. The body and ears are covered with coarse fur. The tail is shorter than the body and head combined. It usually lives in extensive underground burrows which are about a foot or so in depth from the floor. It may also live in the lower part of the walls and in sewers. The black rat is smaller than the brown rat. It has thin and translucent ears and smooth fur and a thin tail longer than the body and head. It is an expert climber and prefers to live in the roofs of buildings or among the branches of trees. These cannot jump more than 30 inches and stretch beyond 8 inches. Mole rats also, which are usually found in the fields, sometimes attack granaries. They generally live in burrows in the field bunds or in the drains.

Control

Rats are prolific breeders. With sufficient food available they breed very rapidly throughout the year. A single female produces in one year five litters each containing nine young. It has been observed that one pair of rats can produce 800 descendants in a year.

The most permanent, economical and the simplest method of control is to make the entry of rats into a godown impossible by making it rat-proof. This can be done by the following measures:

1. The floor should be of cement concrete or of flagstone.

2. Doors when shut should leave no gaps. Rats can gain access into store by gnawing the doors. In order to prevent this, tin strip should be fitted along the bottom four inches of the doors passing the lower end of the strip below the door to the other side and nailed.

3. As rats can jump only about 30 inches, it will be desirable to have window openings about 3 ft. above ground-level. If it is not possible, ½ inch wire-netting should be fitted on the windows. This will prevent rats gaining access into stores through windows. It will be an additional advantage to have the wall below the window perfectly smooth.

4. Lower openings of drain pipes should be covered with well-fitted wire-netting or perforated metal sheetings. If possible the lower three-feet of the pipe should be cut off. Sewer drains should be kept in good repair.

5. In some of the old store buildings complete rat-proofing may not be possible. But necessary repairs should be carried out to make them rat-proof adopting as far as practicable, the measures just mentioned. A constant watch for rat-holes inside the stores should be kept. If any rat-hole is observed, it should be filled with cement containing pieces of broken glass and sealed.

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In planning a new store building, in addition to the points mentioned, the following should also be ensured.

1. The foundation should be 3 ft. deep below ground-level and where this is not possible it should be raised about 2 ft. above ground.
2. There should be one foot ledge at the upper edge of the plinth projected one foot horizontally outwards. The under surface of this edge should be hard and smooth.
3. Floors should have at least 9 in. cement concrete layer to make it impervious to rats. This can be further strengthened by laying closely laid flagstones in cement.
4. Walls should be solid and impervious, built of cement concrete, smooth stones or bricks well-laid in cement.
5. The doors and window frames should be protected with sheet of iron fitted along the side.
6. The flooring should have a cement concrete terrace; alternatively it should be of corrugated iron sheets. Ceiling should be of cement concrete when provided.
7. Rain water pipes or drain pipes should not be carried either under the surface of the horizontal ledge or over the outer surface of the plinth.
8. The building should be well-ventilated, and lighted as rats shun such situations.
9. There should not be any trees very close to the store.

Insecticides

There is hardly any chance of the rats gaining access into a building which has been properly rat-proofed. But it is possible that the rats from the surrounding area may burrow their way into the stores through the ordinary non-concrete floor. In such cases the best method of control is by charging of the burrows with Cyanogas * 'A' or Cymag†. This chemical is in the form of a powder. This powder gives off hydrogen cyanide on exposure to air. Before using the powder all rat-holes in the area should be closed. Those holes which re-open the next day will indicate that the rats are present in them. Cyanogas powder should be applied only in such holes either by placing a teaspoonful of the powder well down the entrance to the burrow or by blowing dust by the use of Cyanogas Foot Pump Duster and the hole sealed with mud. The latter method is better as it ensures equitable distribution of dust all along the burrow. A lethal dose of hydrogen cyanide will be built up on exposure to air and the rats trying to make their way out will be killed. Such holes should be treated with cyanogas. This treatment should be repeated in any reopened holes until all rats are killed. The use of this method should not be attempted without due precaution in godowns situated in populated localities or in godowns full of stocks. Cyanogassing of burrows should be avoided during the rainy weather or in water-logged areas. It will be advisable to have the treatement carried out by a skilled operator as the powder being highly poisonous is likely to prove dangerous when handled by a layman.

Traps

Any remaining rat infestation can be dealt with by using traps. Trapping in fact should be a routine anti-rat measure in stores where complete and thorough rat-proofing is not possible. This method has the advantage that it can be used with safety. The success by trapping depends on employing sufficient number of traps being placed in the alleyways in godowns. The traps with suitable baits should be placed in the evening and the rats caught in should be disposed of the following morning. It is the usual practice to let off these rats just outside the stores. This is a dangerous practice as the rats will come back again and infest the stores or may infest other buildings in the locality. The rats caught in should at all cost be killed by putting them in kerosene-water. The rats thus killed should be buried deep in the ground. All traps should be collected and placed in a separate room during the working hours. It is essential that the cages are cleaned after use with hot water.

The bait material should be such which the rats cannot normally obtain. Cheese, bread, meat, biscuit, fruits will be quite attractive. Baits should be changed daily and varied as much as possible. It would be useful to try some baits and determine which one is readily taken by the rats. No poison is required to be mixed with these baits as these are only meant to lure rats in the cage.

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*Available from Messrs. Shaw Wallace & Co., Ltd., Calcutta.

†Available from Messrs. Imperial Chemical Industries, Ltd., Calcutta.

Wire cages** are the most satisfactory type of traps. Cages made out of a heavy guage wire or strip will be strong and it will prevent rats from escaping by bending the wire. The tilting platform of such traps should be made to close by counter weights in preference to a spring.

'Break-back' traps are also useful against rats. These should be set in pairs and about nine inches apart. As far as possible the traps should be set at right angles to the runways of rats.

The methods are quite simple and easy to adopt. It is, therefore, incumbent on all responsible for preservation of foodgrains to employ these methods against rats and thereby save foodgrains from waste and deterioration. A concerted effort in this direction would be a definite contribution towards providing more food.

If you are faced with this problem you can contact the Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture, Government of India. The Directorate will give every possible assistance in this direction.

**Those cages which conform to the specifications laid down by the Director, Haffkine Institute, are satisfactory.

RESEARCH ON EGG PRODUCTION

RESEARCH carried out on the production of eggs by Indian birds at the Indian Veterinary Research Institute, Izatnagar, show that under controlled conditions considerable improvement can be effected both in the quality and quantity of eggs produced. A pen of indigenous fowls was raised in 1939 from the ordinary bazar eggs at the Izatnagar farm. By pedigree breeding over a period of nine years, controlled system of feeding, housing and management the Institute has been able to produce 150 eggs per bird against an average production of a little over 100 in a year. Individual birds have laid well over 200 eggs each weighing near about 2 oz. Furthermore, these birds have stood well the adverse climatic conditions prevailing in the country. They eat relatively less, at the same time laying as many eggs as pure-bred fowls in this country.

Controlled breeding has also provided for increased rate of growth, early maturity, a definite and progressive increase in the weight of eggs as well as the average egg production of the hens. The improved village fowls of Izatnagar have won challenge cups and first prizes consecutively for two years at the All-India Poultry Shows held in New Delhi.

HELMINTHIC INFESTATIONS IN SHEEP AND GOATS

By B. M. PRASAD

OF the many domesticated animals, sheep and goats rank next in importance to cattle. The value of this class of animals providing meat, milk, skin, etc. cannot be underestimated.

Of all the sheep and goat diseases, including those of virus, bacterial, constitutional or other origins, those due to parasitic worms are admittedly the most outstanding since worms take a heavy toll and are very insidious in undermining health of the host. Although figures are not available in regard to the actual loss suffered in different parts of India as a result of worm infestations in ovines, the loss due to this condition must obviously be much greater than in any other domestic animal. Apart from causing death to the affected animals, the worm parasites render their flesh unfit for human consumption, affect their capacity for wool production, both in quality and quantity, depreciate the value of their skin and render the intestines unserviceable for commercial purposes. The Indian stock-owner, while otherwise zealous about the welfare of his animals, is apathetic to the enormous economic loss due to worm parasites. The main cause of his indifference, however, is the lack of appreciation of the appalling damage that these parasites are capable of producing, without showing much objective evidence and doubtless partly to the feeling of defeatism in controlling the pest, as no systematic investigation has been carried out in this country to evolve any method of control consistent with the limited resources of the average herdsman and the peculiar geographical conditions of the country.

Parasitic worms, like all other animals, have a fully grown-up stage which is known as the adult stage and a younger stage called the larval stage. When fully grown up, a 'Fluke' is somewhat like a leaf; tape worms as their name implies are long and broad like a ribbon, and the round worms are long and cylindrical. The animals upon which these parasites lay their hold are called the 'hosts'.

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Location of the parasites

It may be remarked that no part of the host body is immune to the attack of parasites. They are found inside the muscles, the body cavity, brain, eyes, ears, nose, throat, wind pipe, food pipe, liver and lungs and blood vessels. Each kind of parasite finds a suitable spot in the body where it can thrive and lay eggs without interference, and, although it has no desire to do any harm to the host as it will threaten its own existence, it cannot possibly avoid doing some damage. To maintain life, the parasite has to obtain its food from the tissues thus depriving the host of nutrition, which has certainly a most deleterious effect on the latter's health and may in severe infestation bring about death.

Mode of spread of the disease

The life-histories of parasitic worms and the manner in which they pass from one animal to the other provide some of the most amazing stories of nature. In most cases the parasites lay eggs in the body of the host, which are voided with the dropping, urine, sputum or nasal discharge of the affected animal. In some cases the infection of animals in contact occurs through the ingestion of these eggs, while in other cases the life-history is more complicated and may take place through the intermediary of other species such as snails, slugs, mosquitoes, fleas or other biting insects. The insanitary condition prevailing in the country greatly facilitates the spread of the disease. Animals pick up food or graze upon pastures contaminated with the excretions of worm-infested animals and in this way parasites find their way into the healthy body. Uncontrolled movement of animals is responsible for the spread of the disease from one locality to the other. Flocks are taken by the nomadic shepherd from one place to another in search of pasture and there is an annual movement of the population from the plains to the hills in hot weather and over long distances on the plains during monsoon.

Worms and the damage caused by them

Flukes: The class of worm known as flukes live in the liver, lungs, bowels, blood vessels and nose of their hosts. Liver-flukes cause what is known as 'liver-rot' in sheep and goats, a very serious condition which may be responsible for a heavy annual mortality. The lung-flukes cause respiratory troubles. The bowel-flukes produce bowel disturbances such as persistent diarrhœa. The flukes themselves cause insignificant injury; but great damage is done by the eggs they liberate. The eggs accumulate in the minute blood vessels of some organs; the vessels rupture as a result of increased tension and a disease is caused in which affected animals pass bloody stools. An important disease known as 'gillar and pitto' in some parts of India, in which the chief symptoms are a dropsical condition of the neck and belly, accompanied by pronounced diarrhœa, emaciation and premature death, is perhaps caused by the red-fluke.

The diseases caused by flukes are very prevalent in marshy areas which are irrigated by canal water and subjected to frequent inundation. The infertile larvæ, residing in the body of snails found in abundance in damp climate, are passed and deposited on water and blades of grasses and animals drinking water or grazing in snail-infested areas become infected with the parasites.

Tape worms: The tape worms in their adult stage usually live in the bowel and cause depraved appetite, digestive disturbances and sometimes obstruction of the bowels. The larvæ of one of the tape worms of dog find their way into the brain of sheep and goat and produce a disease called 'gid'. The larvæ of the small tape worm of dogs produce the so-called hydatid disease of the liver and lungs in all domesticated animals including sheep and goat. In this condition the affected organs of the body contain what appears to be watery cysts or bladder which grow and press upon and injure the healthy tissues. Sometimes these cysts are so numerous and big that a greater portion of liver or lung or both, is extremely obscured, resulting in diminished functional activity or even death.

Round worms: There are various kinds of round worms affecting sheep and goats and their life-histories, habits and ill-effects are more or less comparable with those of hook worms in man. The stomach worms cause severe anæmia, loss of vitality and digestive disturbances. The nodular worm inhabits the large intestines. The young worms imbed themselves in the lining membranes and produce pea-size nodules. Severe infection causes an intractable diarrohœa and consequent emaciation and loss of vitality. The lung-worms cause Pneumonia and 'Husk and Hoose' in sheep and goats. Apart from sucking blood of the host, round worms liberate a kind of poisonous fluid which has a deleterious effect on the health of the host manifested by epileptic convulsions and dizziness.

From the list of worms and the ailments they produce, it will be apparent how varied and numerous are the diseases of domestic ovines caused by the parasitic worm. Although in all cases they do not immediately cause death of the affected animal, the greatest danger lies in the fact that the parasites are continually at work, undermining the health of the host. One redeeming feature in parasitic infestation is that the condition can be successfully treated. It is not the purpose of this paper to give here the various remedial measures, as the diagnosis of the type of worm infestation, choice of the drug, computation of doses, method of administration, preparation of the patient, etc. require skill and experience and hence should be entrusted to persons qualified to undertake such work. The services and advice of Veterinary Surgeons should be sought to combat animal diseases. The treatment should begin in the early stage as once the symptoms set in, it becomes difficult to treat.

Prevention

An essential part of the control of parasitic diseases consists in increasing the general resistance of the animal, and for that purpose proper sanitation, management and feeding are required. Recent investigations have established the fact that the incidence of round worm infection in healthy animals is much less than that in poorly nourished ones.

Flukes: Infected animals should be treated at regular intervals and wet pastures must be avoided and drained off wherever practicable.

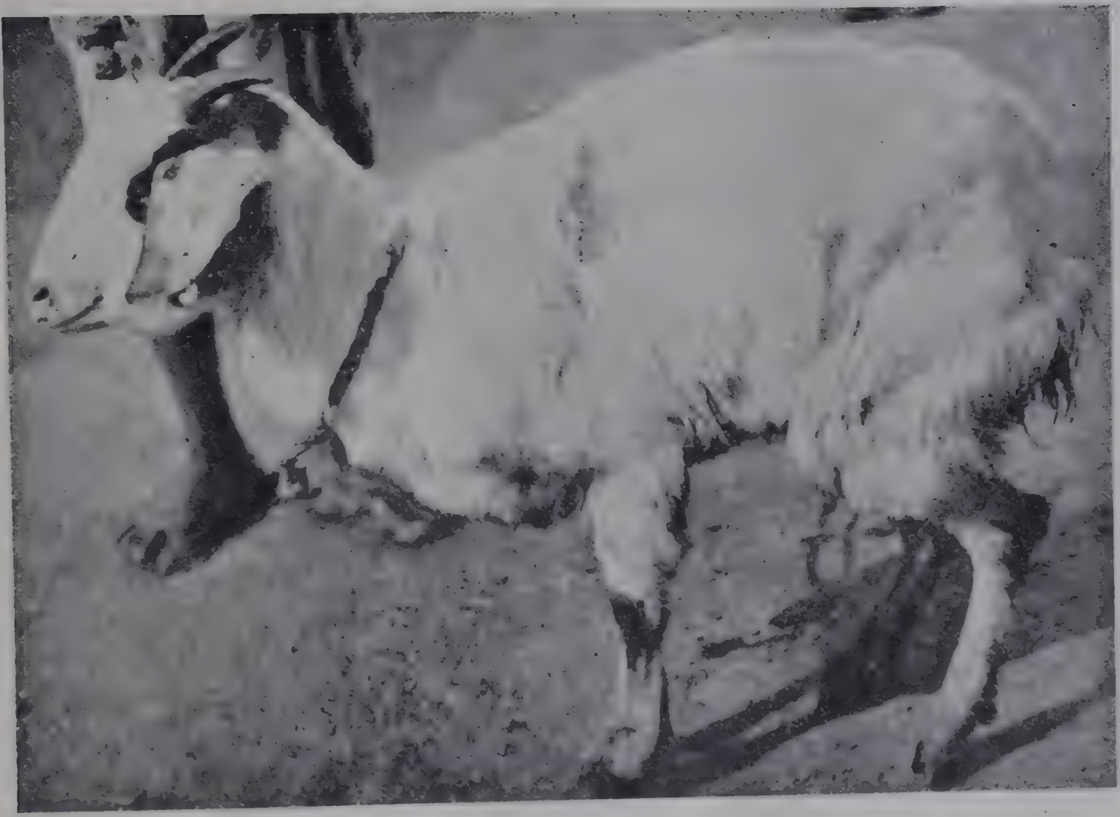

FIG. 1. Goat suffering from 'Pitto' and 'Gillar'.

Grass from infected pastures should not be fed to animals.

An important measure is the destruction of snails which can be done by the application of copper sulphate. A solution of 1 part in 1,000,000 parts of water is usually sufficient to kill snails and many of their eggs, and will produce no ill-effect on the stock. The treatment has to be repeated after three or four months to ensure a complete destruction of newly hatched snails.

In the case of moist pastures, copper sulphate should best be applied in the form of a 1 to 2 per cent solution or a powder mixed with 8 parts of sand. About 15 lb. will be required per acre. Stock should not be grazed on treated pastures until a shower of rain has fallen.

Tapeworms : The ill-effect is not produced by the adult worms themselves, but by the larvæ of some of the tapeworms of dogs and cats and other wild animals, which occur in sheep and goats. As the larvæ cannot be killed by drugs and the disease caused by them is impossible to treat, the regular treatment of dogs and cats for tapeworms and extermination of wild animals which harbour the same are the only natural measures to be adopted. The bladder worms found in the carcass of affected animals should be destroyed to prevent their entrance in the host ; and, for the same purpose, animals suffering from 'gid' should be killed.

Round worms : The animals should be well-fed and supplied with salt licks. Well-nourished sheep are much less susceptible to infection than others and, even if some worms do establish themselves, their effects are rarely noticed. They should be treated regularly for the stomach worms, which are very harmful, as they greatly lower the resistance of the host ; but when the body is freed of these worms, the ill-effects will be overcome easily. It is a good practice to deworm them as far as possible during the dry season, so that the pasture may be sterilized by the sun rays which is considered a powerful disinfectant in the tropic.

Too many animals should not be kept at one place, as congestion tends to increase worm infestation. Since young animals are most susceptible to worms, they should be separated from adults as early as possible and grazed in a clean place. Moisture and dampness lend suitable conditions for the development and maintenance of worm larvæ, and hence animals should be grazed and housed in dry places and the excreta suitably disposed of at a far away place from the habitation.

The sheep and goat population of India suffer a large annual loss from parasitic diseases and the success and failure of the wool and mutton industry depend largely upon the extent to which parasitic diseases can be kept within reasonable bounds.

A GLIMPSE OF ANIMALS 'IN STONE' AND 'IN LIFE'*

By H. K. LALL

ANIMALS have been depicted in the form of paintings, engravings, sculpture, since times immemorial. In every country, the animals inhabiting that particular land have been reproduced. In Africa, for instance, eland, koodo, ostrich, and elephant, which occur there, are seen in the African engravings. Different purposes have been attributed to the reproduction by man of animals in art. Burkett, while referring to the engravings on the walls in the depths of natural caves in various parts of Southern France, and Northern Spain, which according to him were the creation of artists living anywhere from ten to twenty thousand years ago, states, 'these drawings were not art for art's sake but more for ritual purposes'. Animals have been symbolic of religion or gods, or became symbols because they were associated with gods; the Elephant God (Ganesh) and the Bull (Nandi) of Siva, are two of the classical examples in Indian art. In ancient art, as in ancient mythology, there is no distinct line between God, man and beast; this can be seen from pieces of art representing half animal, half man. While at places artists have used imagination in producing artistic work, on other occasions animals have been pictured true to life. Describing the effigy of a cow set up on the Acropolis of Athens, Goldscheider states, 'she was, as those little Greek poems tell us, represented *so true to life* that one waited for her to begin to moo'.

Art in ancient Egypt was done by the artist with the idea of immortalizing himself. The animal which the artist imprisoned in concrete form thus represented the shape of things past, no less than the shape of things to come. In India, one finds in temples the forms of almost all the animals, and Codrington has aptly said, 'Indeed, both in art and literature and also in the real, colourful, vital Indian scenes, the elephant and the humped bull and the monkey are the animals of India'. Referring to the famous bull capital from Rampurva, he says, 'to anyone who knows India, it was perhaps the most Indian of all the many treasures in the Exhibition, for the Indian humped bull is today, as in the past, a feature of the Indian landscape'. Even our national emblem, Asoka's 'three lion heads', has on the abacus a cow and a horse.

The rocks of Mahabalipuran—70 miles from Madras, on the sea coast—present some beautiful samples of Indian sculpture. Amongst those, the statues of cows and elephants stand out prominently. There is an array of cow statues (Fig. 1), each carved out of one single stone. Mute yet expressive, with their backs towards the sea, and looks turned sideways, these patient creatures stand in quiet pose unconcerned with either the beauty or the ugliness of nature. The engraving depicting the milking of a cow (Fig. 2) looks life-like. The young calf seems to be looking timidly for his share of milk. The head is very much like the Kangayam breed of today—which might lead one to imagine, that perhaps very little evolution has taken place in the breed. A massive elephant (Fig. 3) stands in majesty as a sentinel at the entrance to one of the temples adjoining to the rocks. In the background one sees a horse, which is less common in Indian art, though one finds frequent appearance of the famous horses in the Rajput and Mogul paintings. The statue of horse from the famous Kanark temple reproduced in our new series of postal stamps is an exquisite example of artistic workmanship, whose mention will not be out of qlace here.

In one quiet corner of the rocks, there is a carving of a buck, scratching its muzzle with one of its hind foot, in the most natural fashion and a doe looking appealingly to its mate (Fig. 4). They seem to be blissfully resting, away from the din of humanity and safe from the shot-gun of the modern animal lover, who would tread on their skin, rather than see them

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*The author is indebted to Dr B. P. Pal for kindly going through the article and providing the inspiration to write this note.

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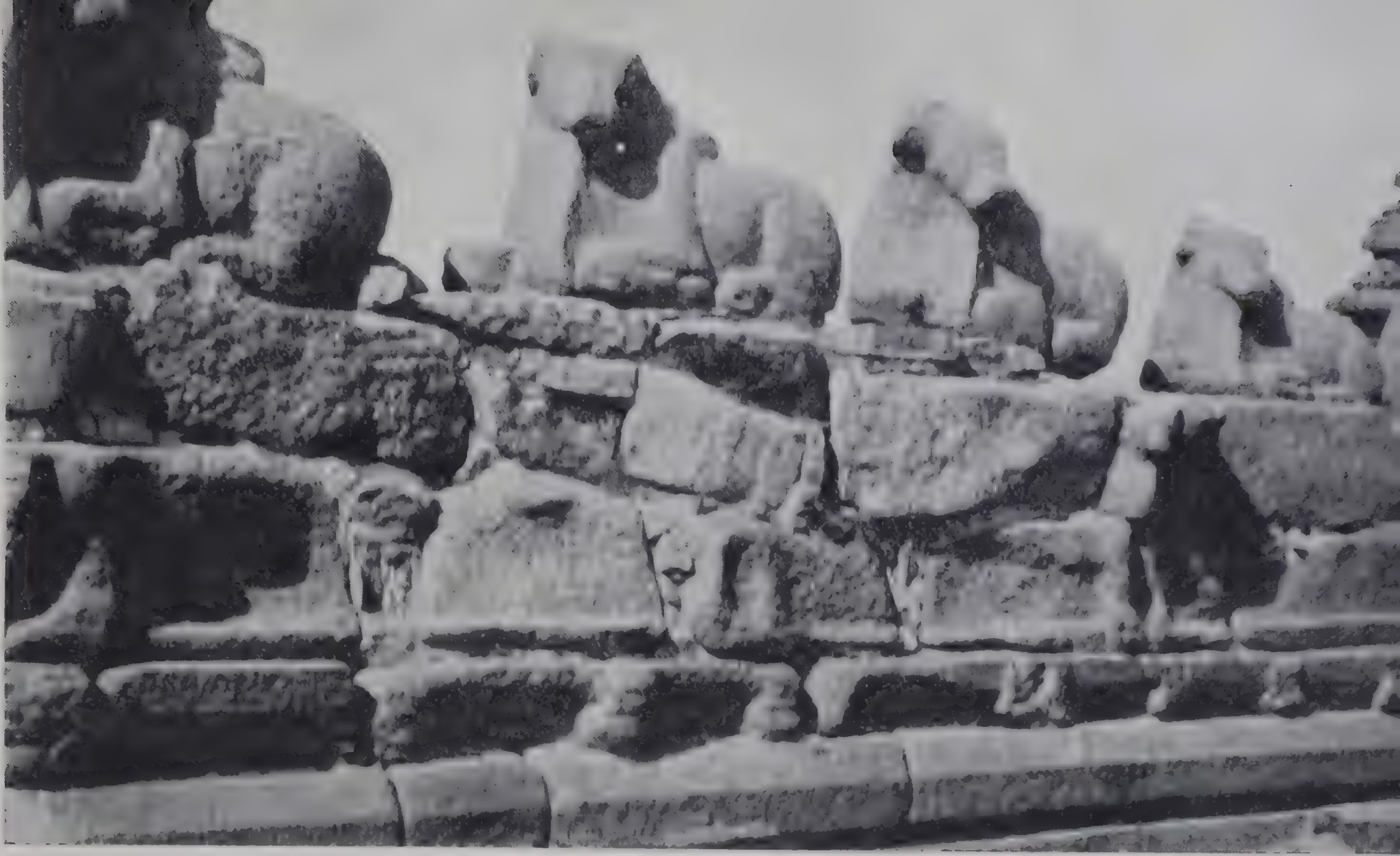
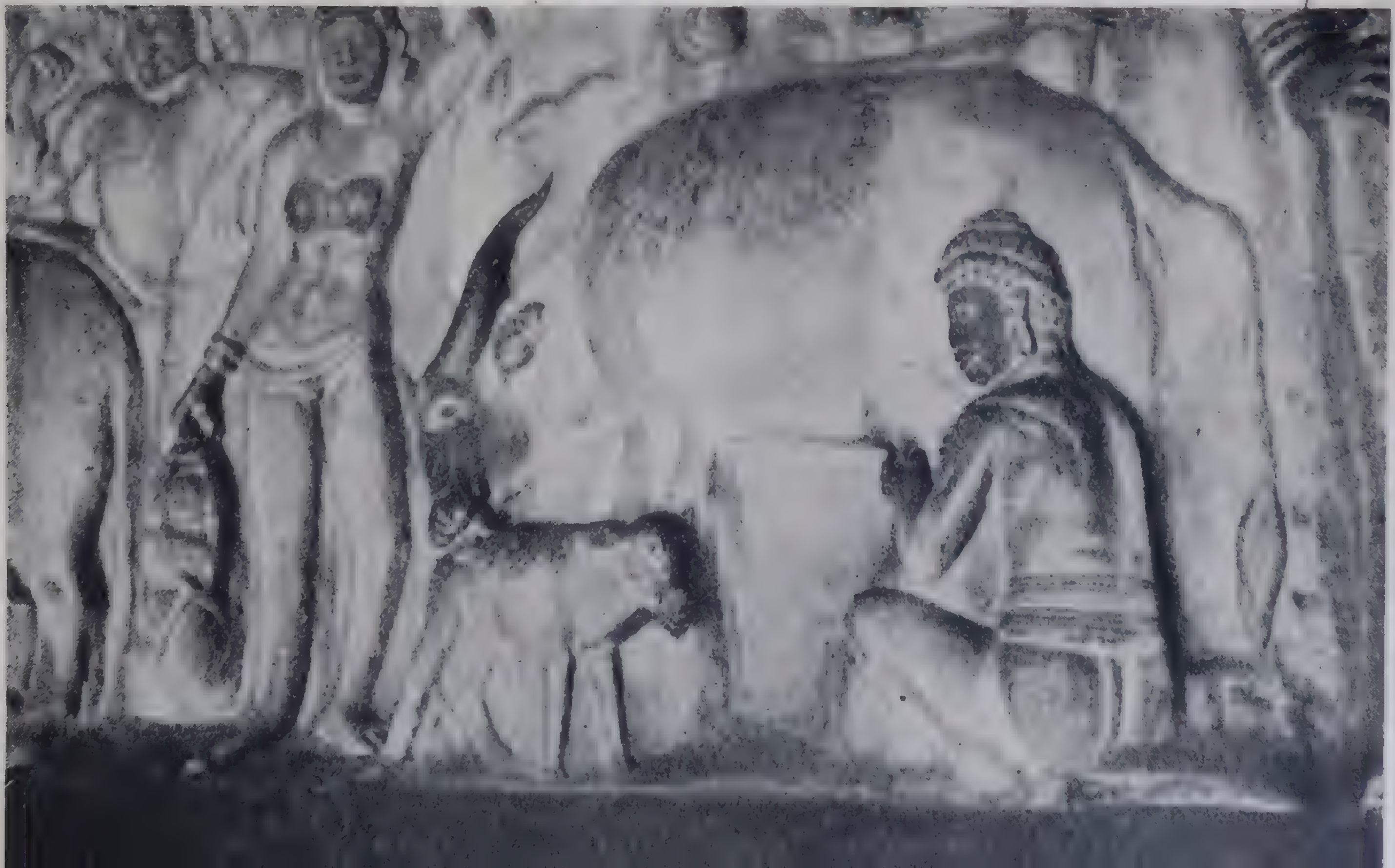


Fig. 1 (above). Statues of cows and elephants on the rocks of Mahabalipuram.

Fig. 2 (below). Engraving depicting the milking of a cow.



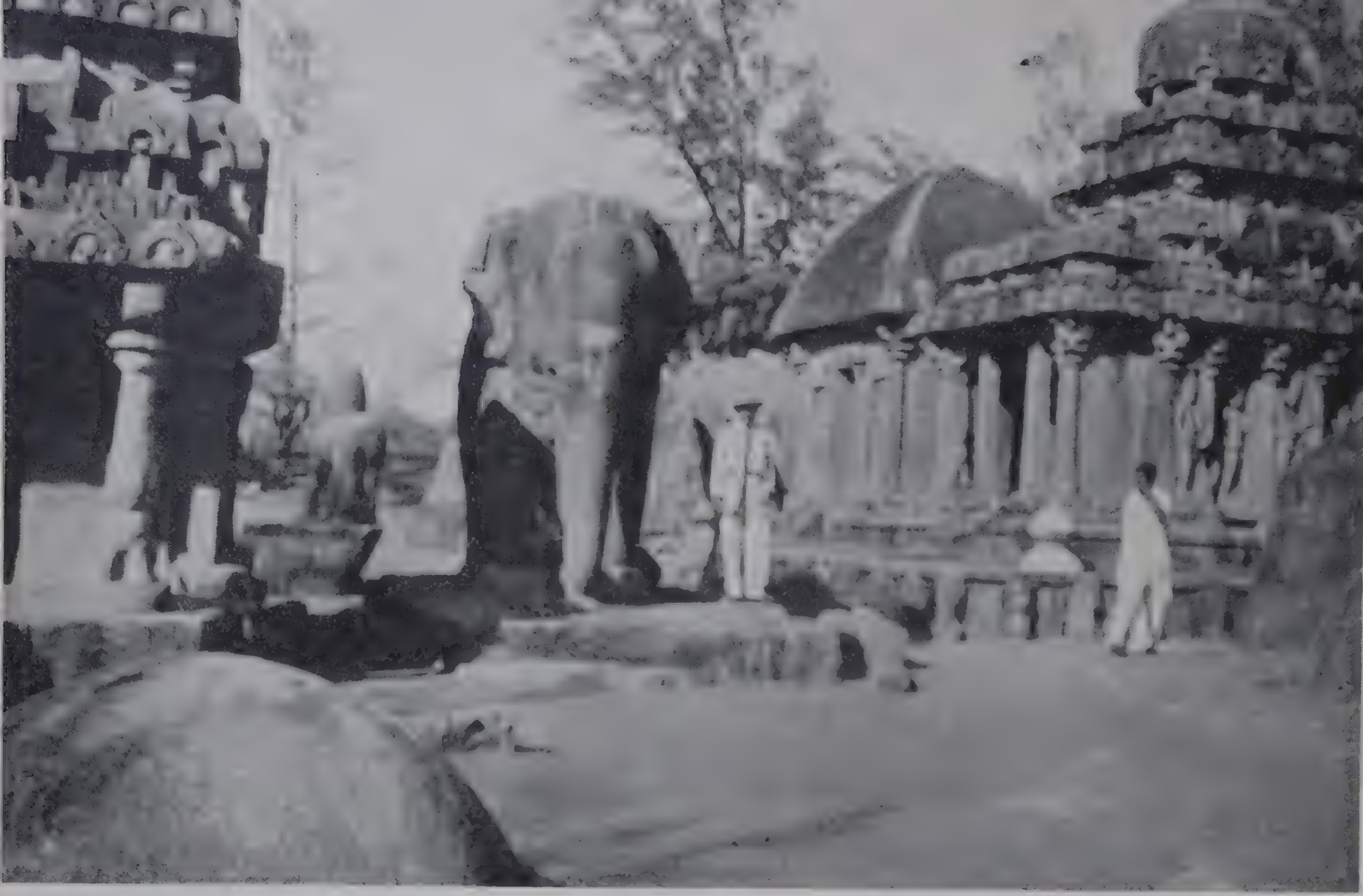
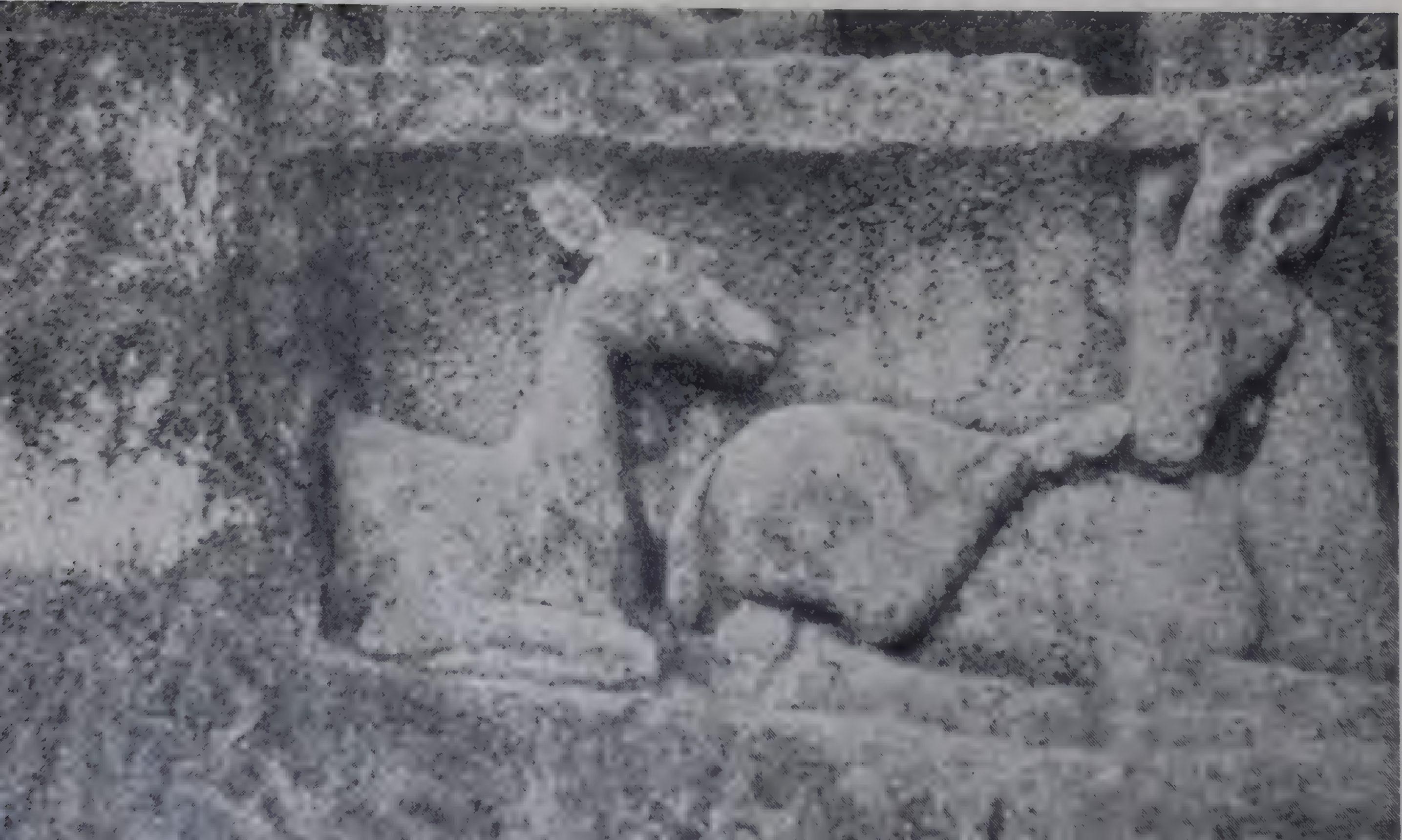
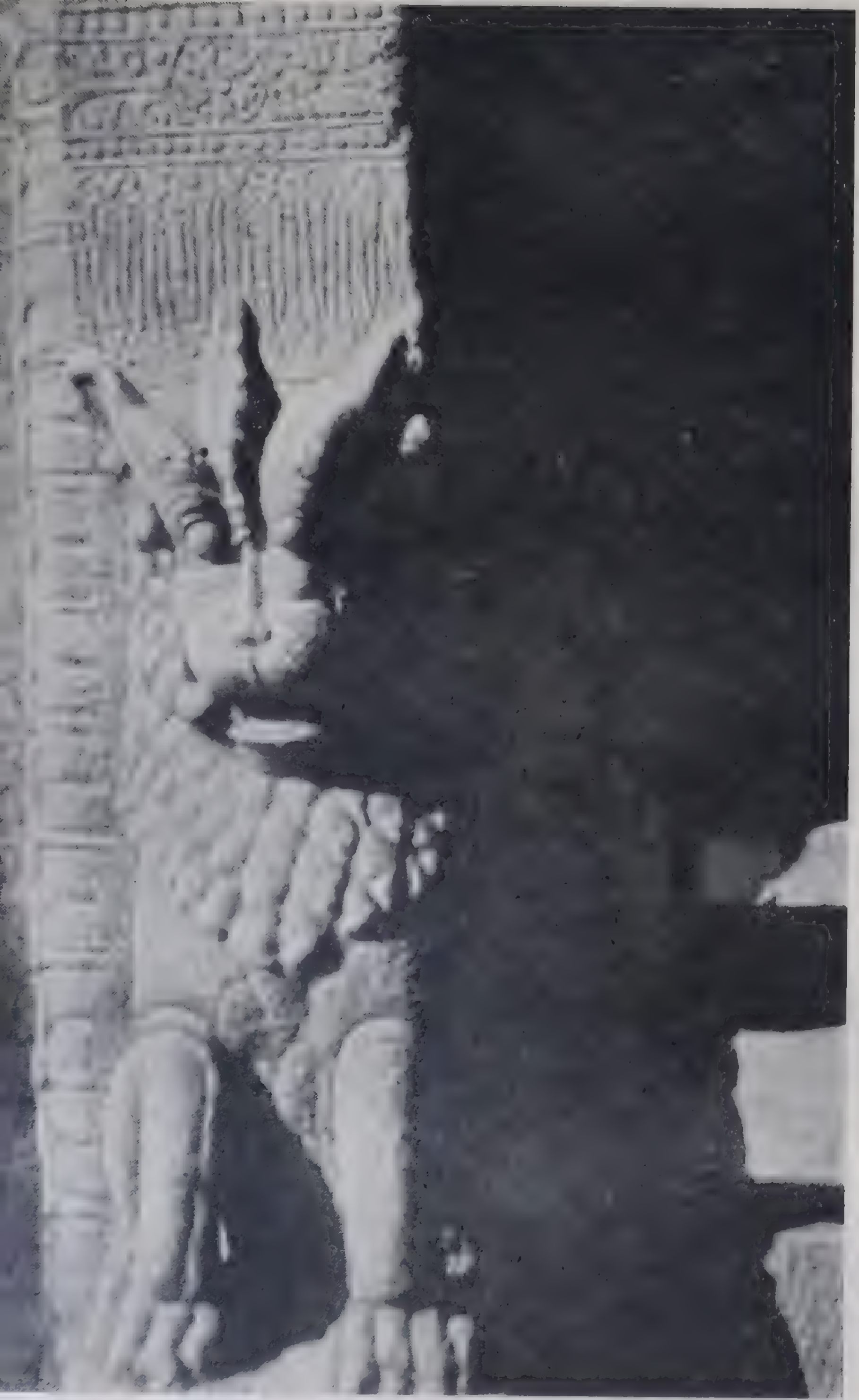


Fig. 3 (above). The rock elephant at Mahabalipuram.

Fig. 4 (below). The buck and the doe.





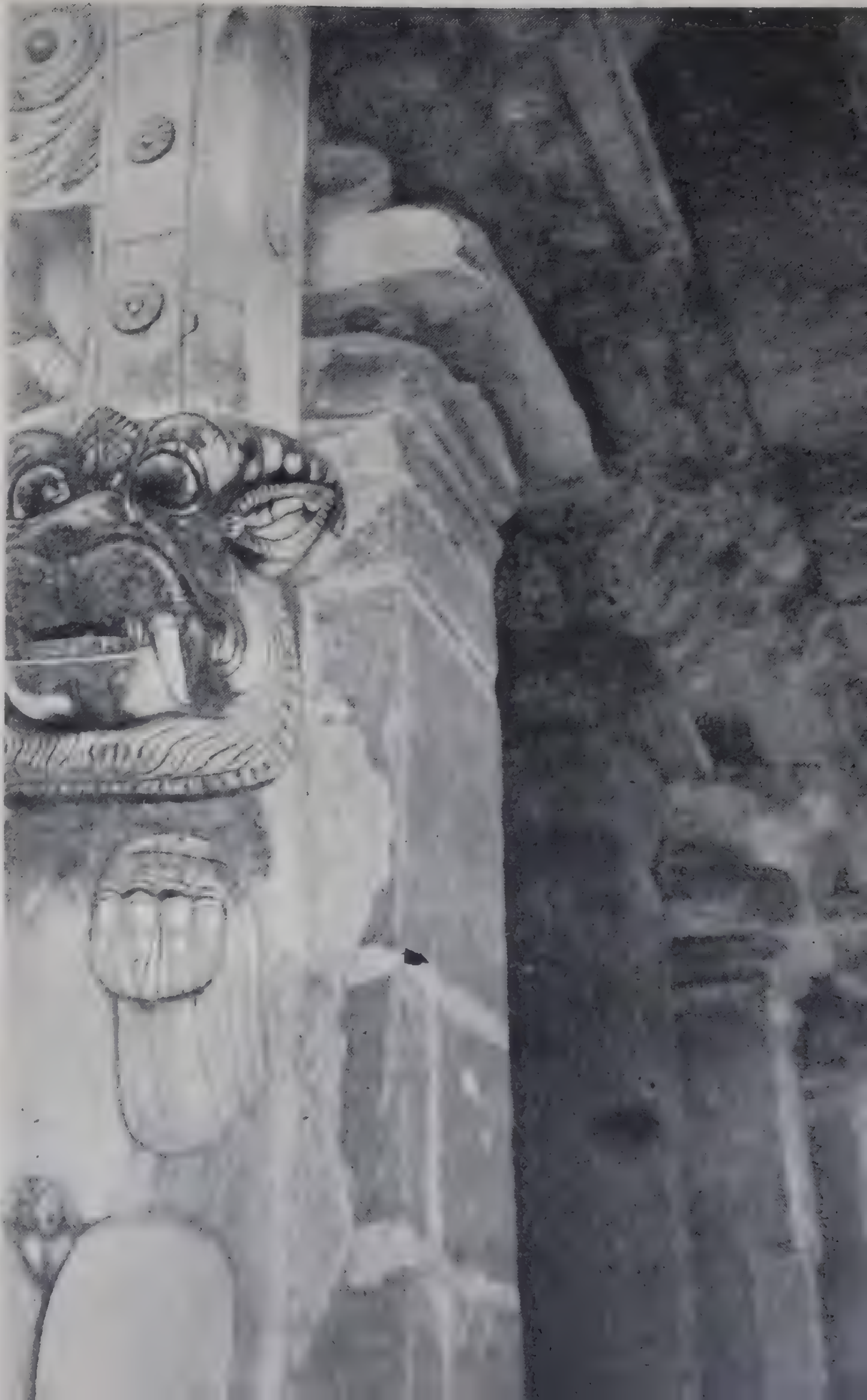


Fig. 5 (right) and Fig. 6 (left).

Engravings of lion in temples at Conjeevaram.

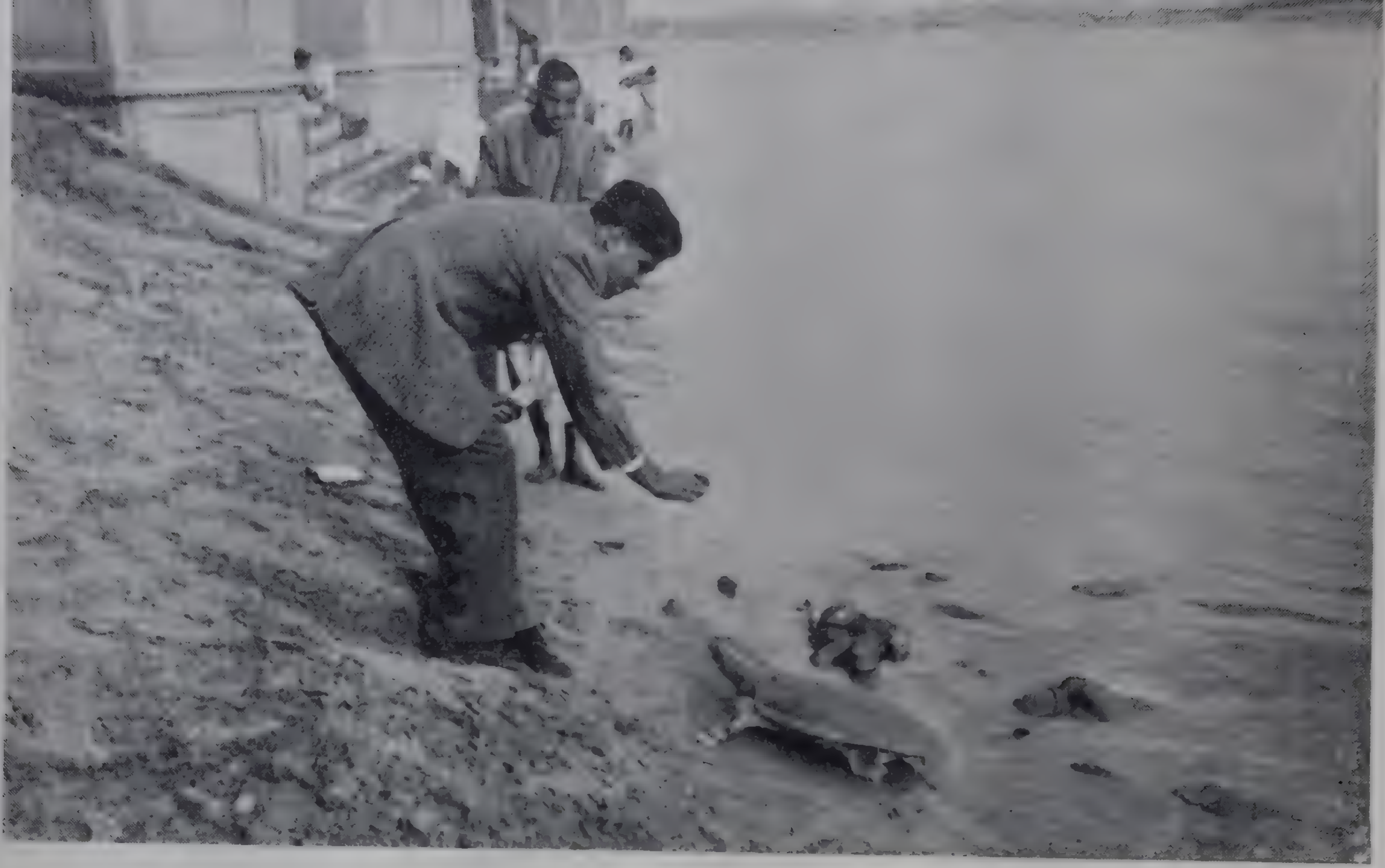
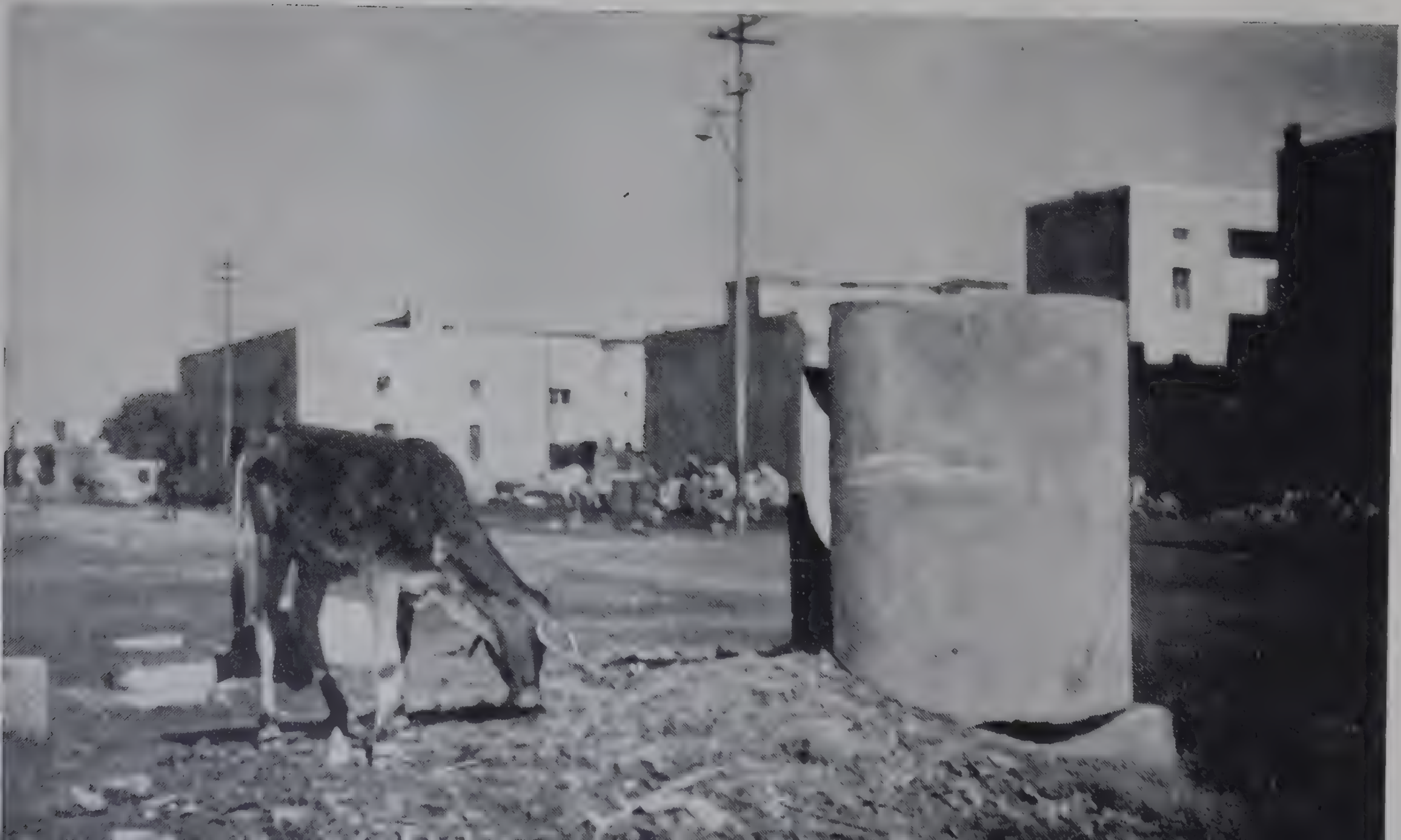


Fig. 7 (above). The author hand-feeding tortoises on the bank of the Jamuna at Mathura.

Fig. 8 (below). A street cow scavenging for food.



living in the wilds and enjoying the bounty of nature.

Whereas these rock sculptures show animal life as 'true to life' as it could be, it is a familiar sight to see the engravings of fictitious animals as well. One instance is that of the 'Narsingh avatar' with its head of a lion and the body of a man. The two illustrations (Fig. 5 and 6) are from two temples of Conjeevaram. The lion, which is rare now, frequented this land in the days gone by, but the story of *Narsingh Avatar* dates back to the days of Bhakt Prahlad when the Lord himself assumed the shape of an animal half-human and half-lion, and destroyed Harnaksha—a demon—at twilight inside the doorway, because this demon was so blessed by the Gods as to be indestructible, either by man or animal, under cover or without cover.

Indian art not only abounds in representations of human life but it is also rich in its expression of animal life. Whether it is the absolute sacredness or the 'love of *ahimsa*' that glorifies and gives sanctity to our peacock, monkey, fish, tortoises, and cows, is difficult to determine but it must be said that they add to Indian life a charm of their own. It is quite an experience to see the well-fed fishes at Hardwar and the familiar tortoises come to feed almost out of the hands of visitors at Mathura (Fig. 7).

Someone has said, 'India is a country of contrasts.' In this land where lovers of *ahimsa* are in abundance, one sees the anatomical abnormalities and disfigurements of body such as the presence of hernia, fibroma, or an extra leg on the body of animal, exploited as a means of livelihood, by the 'street sadhus'; the lovers of the cow, who hold her in high esteem, see hundreds of them scavenging for their existence in the streets of India (Fig. 8). It is a sad reflection on our love of *ahimsa*, for were not these animals worshipped in 'reality' and immortalized 'in stone' ages ago, for the 'life elixir' they provided out of their very selves ?

Acknowledgment

I am indebted to Dr B. P. Pal for kindly going through the article and providing the inspiration to write this note.

F. A. O. EXPERTS FOR INDIAN AGRICULTURE

THE services of two experts of the F.A.O. will shortly be available to the Indian Government to advise them on problems of Indian agriculture. The Central Ministry of Agriculture has under consideration the organization of an agricultural extension service, which would bring to the cultivator the results of scientific research and laboratory experiments conducted by the Central or Provincial Governments. Much progress in this direction has been made in the U.S.A. and the F.A.O. expert will advise the Indian Government on setting up a similar organization in India, with suitable modifications to meet Indian conditions.

The second expert will assist India to prepare improved rinderpest vaccine. The F.A.O. scientists have been assisting Chinese agriculture in the largescale manufacture of an improved vaccine, which is stated to give life immunity to the cattle.—*Food Bulletin*, March 14, 1949.

THE NATIONAL AGRICULTURAL ADVISORY SERVICE OF ENGLAND AND WALES

By S. K. ROY

THE National Agricultural Advisory Service of England and Wales was set up in 1946. The new Service is a part of the Ministry, and its officers are Government servants. Before the formation of this Service, the functions were distributed between County Councils, Universities, Research Institutes, and the Ministry of Agriculture and Fisheries.

The two fundamental objects of this Service are (i) to bridge the gap between the laboratory and the farm, and (ii) to bring to the notice of the farmers the latest scientific devices and practices and to acquaint the scientists with the problems and difficulties of the farmers.

The organization of the Service is briefly as follows :

The headquarters staff in London consists of five Senior Technical Officers with a few assistants and about the same number of administrative civil servants (non-technical).

The country has been divided into eight provinces, and each province is equipped with various laboratories and a library. It is hoped that each province will have at least one experimental farm, and some will have, in addition, a field station of horticulture.

The staff at the Provincial Centre is mainly composed of specialist officers. The various departments are : Soil Science ; Animal Nutrition ; Entomology ; Plant Pathology ; Bacteriology ; Farm Machines ; Agronomy ; Grassland ; Livestock ; Poultry ; Milk Production ; Fruit ; Vegetable Crops ; Glasshouse Crops and Flowers.

Each specialist officer has a laboratory with a considerable staff. The soil laboratory carries about a few hundreds of soil analyses per week, which provide a basis for advice on the use of fertilizers on particular fields.

The County Advisory Officer is the chief officer of the County Agricultural Executive Committee and under him there are a number of specialists, varying according to the local type of agriculture. Normally it includes one horticulturist, one farm machinery instructor, a poultry adviser and a dairy instructress.

Each county is divided into a number of districts, each having about one thousand farms. In each of these districts there is one District Officer and a local committee.

The total number of officers including analysts, clerical staff, is about 1,250.

The responsibilities of the Service may be enumerated briefly as follows :

(a) To operate various schemes directed towards the improvement of food production, viz.

(i) The inspection of licensing of bulls, boars and rams in order to prevent the use of inferior animals for breeding purposes.

(ii) The inspection of flocks of poultry kept for breeding.

(iii) The inspection and certification of growing crops of cereals, potatoes, etc. which are to be harvested for seed and also of herbage plants and vegetables which are to be sold for planting.

(b) To advise individual farmers on technical matters for increased food production and to give instructions to workers for the operation of new machines or for new agricultural methods.

(c) To bring to the knowledge of farmers the applicability and the usefulness of new scientific and technical developments.

(d) To carry out such trials which may be required to find out the local applicability of new discoveries and inventions and to pass on to the Research Institutes problems that seem to call for fundamental investigations.

(e) To provide technical guidance to Agricultural Committees in promoting food production.

The difficulties of the Adviser and especially of the District Officer consist in keeping abreast of the advances of science. This difficulty is met by frequent contacts with provincial

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specialists, and by the organization of refresher courses by research workers themselves about the progress of their respective subjects.

It is too early to estimate the rate of improvement that will be achieved. The target set out for the next four years is a twenty per cent increase in output.

It may be objected that this is a very elaborate machinery and is costly. Nothing short of this can provide 350,000 farmers with competent advice on every problem. The total annual expenditure when the Service is fully developed will be about two million pounds or twenty-seven million rupees. But this, as compared to the annual output of the country's farms, is only three hundredth.

NATURE CONSERVANCY TO PROTECT WILD LIFE

THE formation of a Nature Conservancy for Britain has just been announced by the Lord President of the Council, Mr. Herbert Morrison. This body will have charge over everything concerned with wild animal and plant life and be responsible for their protection.

It has 16 members, with Professor Tansley, who is Professor of Botany at Cambridge University, as Chairman. The other members include four experts in botany, four zoologists, a geologist, a forestry specialist and a distinguished scientist.

A separate committee will supervise activities in Scotland. Its chairman is Professor Matthews, who is Professor of Botany at Aberdeen University and an expert in soil research.

The Conservancy will manage the national nature reserves which are to be established in Britain. It is proposed that 73 such areas shall be preserved, each being of some special scientific interest. Many of these will fall within the 12 big national parks to be created. (*London Press Service.*)

SOME RESULTS OF RESEARCH ON RICE

UNDER the auspices of the Indian Council of Agricultural Research there are now in progress 68 research schemes distributed over the various constituent provinces and States of the Indian Dominion which aim at improving the yield and quality of the principal agricultural crops and fruits. Of these, 37 research schemes relate to foodgrains, 22 fruits, 4 potatoes and the remaining 5 the miscellaneous crops—cardamom, turmeric, cloves, coriander and pepper. Out of the 37 schemes on foodgrains rice accounts for 8, wheat 4, maize 4, pulses 14, millets 5, gram 1 and soya beans 2.

The current research schemes on rice which is the principal food crop of India are directed towards one or the other of the following objectives:

(i) Producing superior strains possessing higher yield and better quality by the application of plant-breeding methods.

(ii) Combating the fungus diseases and insect pests which attack the crop and consequently diminish the yield.

(iii) Increasing the yield by the application of manures and fertilizers.

Rice breeding

This work is located at four widely distant regions along the entire length of the country, namely (a) Kashmir, (b) Bombay, (c) Hyderabad and (d) Travancore under four separate schemes.

(a) *Kashmir scheme:* The work done so for has revealed the possibilities of successfully growing rice on high altitudes ranging from 7,000 to 9,000 feet where cereals do not thrive owing to the short season. Considerable progress has been achieved in the successful introduction of foreign varieties of rice such as Russian and Chinese types. The former variety has proved early maturing and is harvested about six weeks earlier than the local. The Chinese rices are high yielders producing from 5,000 to 6,000 lb. per acre. This represents an increase of 60 per cent over the yield of indigenous types and consequently the Chinese types are in great demand from the cultivators. The seeds are being multiplied for distribution.

(b) *Bombay scheme:* The object of the scheme is to obtain improved strains suitable for cultivation in the rice tracts of Gujerat, Surat, and North Thana districts of the Bombay Province. As the scheme came into operation only in June 1945 it is yet too early to achieve the desired effect but in the breeding trials at Nawagam promising progenies selected from the improved local varieties hold out future promise as regards yield.

(c) *Hyderabad scheme:* This scheme commenced in April 1944 with the object of evolving high yielding late maturing strains of paddy possessing good cooking and milling qualities. Work is in progress.

(d) *Travancore scheme:* This scheme started functioning in October 1940 for increasing the yield of paddy crop in the State. Three promising strains of the broadcast type at Adoor Farm proved to be the best yielders and the seeds of these are under multiplication. Of the transplanted type six strains proved superior and these are also being multiplied at farms of registered growers. The Russian varieties tested proved inferior to the locals in yield.

Rice disease

Investigations on two important diseases of rice which are responsible for considerable annual loss of yield in Madras Province began in July 1943. They are:

(a) 'Blast' disease caused by the fungus *Piricularia*.

(b) 'Root-rot' disease caused by the fungus *Fusarium*.

The scheme aims at devising suitable methods of controlling the two diseases, such as the utilization of resistant varieties and the use of fungicides which will reduce the loss in rice production.

(a) '*Blast' disease:* The resistance of 300 varieties of rice to 'blast' was evaluated by growing them under conditions favourable for the spread of infection. They were further subjected to artificial inoculation under controlled conditions. The factors responsible for disease resistance in rice were studied when it was revealed that the number of silicated epidermal cells per unit area was greater in the resistant types than in the susceptible ones.

(b) '*Root-rot*': Two strains (G.E.B. 24 and Ptb. 7) proved highly resistant to this disease.

Trials with four fungicides (Certosan, Atiran, Ceresan and Agrosan) revealed that though all of them were effective in controlling the disease to a certain extent, the latter two were better. The dosage used was 1 gm. of the fungicide for one pound of seed.

Rice pest: The bionomics, alternate host plants and control measures of two major insect pests of rice in Bengal, viz. Rice hispa and Rice stem-borer which cause considerable damage to the rice crop were studied in a scheme from March 1944.

In addition to this, a general survey of all the important pests of paddy throughout Bengal was also made. These included grasshoppers, army-worm, cut-worm and mealy bugs.

The stem-borers completed their life-cycle on rice crops in those parts of Bengal where a summer crop is grown but had to pass on to an alternative host plant in regions where 'boro' summer crop was not raised.

The rice hispa found an alternative host in many wild grasses in Bengal. Of the insecticides tried to control this pest, Gammaxene and D.D.T. were found to be more effective than either Paris green or the arsenates of lead and calcium.

Rice manuring

A notion is widely prevalent that the continuous application of sulphate of ammonia to the same land year after year may result in a deterioration both of crop yield as well as soil fertility. In order to find out if this is true and to determine whether the application of lime or organic manure in conjunction with the chemical fertilizer would obviate the deleterious effect, a scheme was started in Bengal in June 1945, the experiments being located at three different centres viz. Dacca, Chinsura and Rajshahi Farms. The results obtained during the 1946-47 season have given the following indications which have to be corroborated by trials in subsequent seasons before definite conclusions could be drawn.

At Dacca Farm the application of ammonium sulphate alone did not produce any significant effect on the yield of paddy grain but in conjunction with lime, it gave significantly increased yields. But similar results were not obtained at the other two experimental centres. The application of ammonium sulphate alone at Chinsura and Rajshahi Farms resulted in highly significant increase in yield of grain but the addition of lime did not produce any better effect.

The manurial requirements of rice were also studied under the Rice Research Scheme in Kashmir to which reference has already been made. The application of nitrogen in the form of ammonium sulphate at 30 and 60 lb. of nitrogen per acre gave 6 and 18 per cent more yields respectively. Sulphate of potash at 60 and 80 per cent per acre was able to increase the yield by 5 and 6 per cent respectively. Higher yields were obtained by the application of ammonium sulphate in conjunction with organic manure than with organic manure alone or no manure at all. The application of rape oilcake at the rate of 20, 40 and 60 lb. of nitrogen per acre resulted in increased yields of 5, 26 and 36 per cent respectively. But their use is not profitable owing to the high price of oilcakes in Kashmir. The farmyard manure at the rate of 180 lb. of nitrogen per acre gave 29 per cent more yield and Rs. 49 net profit per acre over the minimum dose of 60 lb. of nitrogen per acre.

The Rice Research Scheme in Hyderabad has also been conducting manurial experiments with a view to study the effect of application of nitrogen, phosphorus and potash in increasing yields. Bulk organic manures such as castor cake, groundnut cake and farmyard compost were also included in the trials. Work is in progress and further results have to be awaited. (R. S.).

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Have any experiments been conducted in India to test the effect of Hexyclan powder as a tickicide?

A. With a view to test the insecticidal properties of Hexyclan, trials have been carried out at the Indian Veterinary Research Institute, Mukteswar. Due to the non-availability of the insuffulator, the drug was dusted on the body of tick-infested cattle by means of a piece of cloth. The effect of dusting was determined by making observations at intervals of 24 hours after each application. A batch of heavily tick-infested cattle, out of which two were kept as 'control' were used in the trial. The cattle were infested with *Boophilus australis*, one of the commonest cattle ticks prevalent in India. A brief account of the trial is presented below :

Experimental animals	Life-cycle stages of ticks	Percentage of tick mortality after 24 hours	Percentage of tick mortality after 48 hours	Percentage of tick mortality after 72 hours
Treated cattle	1. Larvae	80 per cent	100 per cent	..
	2. Nymphs	80 per cent	100 per cent	..
	3. Adults	80 per cent	75 per cent	100 per cent
	4. Engorged females	Nil	Nil	Nil
'Control' cattle	1. Larvae	Nil	Nil	Nil
	2. Nymphs	Nil	Nil	Nil
	3. Adults	Nil	Nil	Nil
	4. Engorged females	Nil	Nil	Nil

An analysis of the above results would show that Hexyclan powder is effective for the control of ticks in their larval, nymphal, and un-engorged adult stages. But the engorged female ticks survive the tickicidal action even at the end of 72 hours after the drug is applied.

In order to study the possibility of any metabolic reaction on the treated engorged female ticks, a few specimens were incubated for oviposition at a temperature of 29°C. Practically in every case the engorged female tick had oviposited in a normal manner after a period of 7 to 10 days incubation. The eggs thus obtained were left in the incubator for hatching. Normal hatching occurred in every case. The most interesting fact to be recorded is that invariably the larvae died 5 to 7 days after hatching in spite of the fact that they were well-protected against temperature and humidity and were properly fed under natural conditions. (I.V.R.I.)

What's doing in All-India

MYSORE

M. L. N. IYENGAR

THE Mysore land tenure system is mainly *ryotwari*. Of the total State area of 18·87 million acres, only 1·48 million acres are alienated tract, composed of *jahagirs, inams*, etc.

The annual land revenue assessment is about Rs. 130 lakhs or about one-sixth of the total State revenue. The incidence of this assessment is Rs. 2-2 per head of population and Rs. 2 per acre cultivated. There are about 13 lakh agricultural holdings in the State, nearly 11 lakhs being less than 10 acres in extent. Of the total land revenue of Rs. 130 lakhs, Rs. 70 lakhs are contributed by about 12 lakh landholders paying Rs. 25 and less.

Revision of land revenue system

With a view to get the whole problem of land revenue, tenure and tenancy examined *de novo* in the light of reforms that are being recommended in Indian provinces, a Committee consisting of 27 non-officials (mainly from the Legislature) and the Revenue Commissioner has recently been constituted. The following are some of the main terms of reference of the Committee: (1) Feasibility of a basic land tax as a substitute for the present land assessment. (2) Measures necessary for the prevention of fragmentation of holdings. (3) Exemption of uneconomic holdings from taxation or assessment. (4) Formulation of a Tenancy Law on the Bombay model. (5) Augmenting revenue from irrigation works. (6) Abolition of *jahagirs, inams*, etc.

Rural development scheme

The rural reconstruction work in the State is shortly to be reorganized. Some years ago, rural development work was mainly concentrated on what were called 'Model Villages'. As this appeared to touch only a fringe of the problem, a more comprehensive 5-year Scheme was launched in 1943. Under this Scheme, the unit for development was a *hobli* comprising a number of villages. About 160 *hoblis* were selected for work. About 250 honorary workers designated as *Gramasudarakas* were trained in rural work and posted to these *hoblis*. Taluk Advisory Committees were constituted to review the progress of the Scheme from time to time and guide the work in selected *hoblis*. A Special Officer for rural development and District Development Officers for each district were appointed. The following Table gives some idea of the progress made so far under the Scheme.

TABLE I

Progress of rural reconstruction drive
(*July* 1943—*June* 1947)

	Programme	Achieved
Drinking water wells sunk ...	3,219	1,740
Drainage works completed ...	3,305	2,610
Formation of roads (lengths in miles)	2,711	1,699
Tank restoration works ...	378	58
Planting of fruit and other economic plants		
(a) Number of plants ...	...	4,29,722
(b) Number of villages ...	3,401	3,400
Number of schools opened ...	468	366
Number of adult literacy classes held	6,215	6,300
Number of libraries and reading rooms opened ...	3,523	3,175
Value of agricultural implements sold	...	Rs. 3,94,510
Value of improved seeds sold	...	,, 2,74,048
Value of manures sold ...	...	,, 5,91,633
Number of agricultural demonstration plots laid ...	6,200	6,200
Number of bulls supplied ...	564	311
Number of beehives supplied		451
Number of poultry supplied ...		3,381

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Although a good amount of work has been done under the Scheme, the drive has not been found to be as effective as desired. The popular Government have taken up this question and are shortly announcing their new scheme. It is learnt that the honorary *Gramasudarakas*, who have not functioned in the manner contemplated, are to be replaced by paid Taluk Development Officers who will integrate the work of all departments, so far as rural reconstruction is concerned in each taluk.

Development of cottage industries

Although Mysore has developed a number of heavy and medium industries like iron and steel, cement, paper, sugar, chemicals and fertilizers, textiles, soap and silk, village industries have not been neglected. The number of people engaged in rural and cottage industries was declining as elsewhere. While there were nearly 48,000 families engaged in these industries in 1931, it had declined to 41,413 families in 1941. To arrest this decline and revive the languishing or forgotten industries, steps were taken in 1937 to infuse new life into them by opening a large number of training and demonstration centres. In 1939, a three-year plan for the resuscitation of old industries was launched and in subsequent periods, larger and larger grants were placed at the disposal of the Department of Industries and Commerce for this purpose. While in 1938, there were only eight such centres, the number increased to 54 in 1946-47. In addition to this there were 25 centres for home crafts. During the same year, an economic and industrial survey was carried out in 135 villages with a view to explore the possibilities of establishing nine village industry centres.

Recently, a three-year plan for the development of cottage industries at a total cost of Rs. 25·53 lakhs has been sanctioned. Under this scheme it is proposed to have about 107 cottage industries centres in the State, the expenditure on this account to be met from the Industrial Development Fund to which considerable sums have been credited in recent years.

Another Scheme which is under consideration relates to the establishment of small workshops in important rural centres for the manufacture of agricultural implements and domestic hardware.

Legislation

One of the Bills passed at the budget sessions of the Legislature relates to the prevention of cow-slaughter. According to the preamble, the object of the Bill is to 'preserve and increase the supply of milch cattle and draught animals by stoppage of slaughter of cows, bulls, bullocks, buffaloes and calves and by preventing the export of such animals for slaughter outside the State'. This question was being repeatedly pressed in one form or another in the Legislature for a long time. In 1926, a Committee was appointed to consider the whole subject. The Committee reported in 1929 that legislation was necessary, but that it might be of a limited nature to include all heifers, cows in milk and pregnant cows. Since then, particularly during the war, there has been some reduction in the cattle population in the 'buffalo bull' and 'youngstock' groups.

FISHERIES CONFERENCE

BAINI PRASAD

REALIZING the importance of fish production in the food economy of the country, the Government of India have been trying for some years past to increase the production of fish and fishery products in India. Their efforts have been directed in two directions, viz. (1) Undertaking research, pilot experiments and training and (2) subsidizing, under 'grow more food' campaign, approved schemes of provinces and States designed to increase fish production. The results so far achieved, though encouraging on the whole, have not been quite as satisfactory as was expected.

In order to review the work of fisheries development so far carried out in India and to prepare coordinated plans for the future, the Ministry of Agriculture, therefore, convened a Fisheries Conference of the representatives of the Provincial and State Governments and other interests in New Delhi from 27 to 30 September, 1948. The Conference, which was held in the Council Chamber, was inaugurated by Hon'ble Shri Jairamdas Daulatram, Minister for Agriculture, and was presided over by Mr. K. L. Punjabi, I.C.S., Secretary, Ministry of Agriculture. As the Conference was to consider matters of a technical nature, Provincial and State Governments had been requested to nominate, if possible, the heads of their Fisheries Departments, who could be accompanied, if necessary by their senior fishery experts.

The Conference was attended by representatives of all the nine Provinces, two Centrally Administered Areas (Delhi and Amjer Merwara) and eight States (Travancore, Baroda, Tehri Garhwal, Junagadh, Cooch Behar, Bhopal, Rajasthan, Jammu and Kashmir). Fisheries experts and other officers of the Ministry of Agriculture and representatives of a number of other Ministries of the Government of India directly or indirectly interested in the development of fisheries were also present. Dr G. L. Kesteven, Regional Representative (Fisheries), F.A.O., for South-East Asia was also specially invited to attend the Conference.

The agenda for the Conference covered almost all aspects of fisheries such as marketing, refrigeration and transport, statistics, problems relating to inland and marine fisheries, research, technology, equipment and gear, administration, education and training and socio-economic work amongst the fishermen. Explanatory notes on various items of the agenda and memoranda prepared by the Provincial and State Governments and the Indian Council of Agricultural Research regarding fisheries development and research were circulated to all the delegates in advance.

After the Conference had been inaugurated, Mr. K. L. Punjabi made a few opening remarks and Dr Baini Prasad, Fisheries Development Adviser to the Government of India, reviewed the present position of the development of fisheries in India.

During the general discussion that followed, the representatives of several areas raised the question of financial assistance by the Government of India to Provincial and State schemes of fisheries development. In reply Shri Jairamdas Daulatram stated that, broadly speaking, all schemes which were likely to result in increased fish production within the next two or three years would receive favourable consideration. He also stated that the Government of India were soon setting up a Priorities Board for examining, especially from the view point of their financial commitments all schemes of development at the Centre or in the provinces. Officers from the Central Government would be visiting the provinces to discuss schemes of increasing production of food (including fish) with the Governments of the various units. It would, thus, be possible for provincse to know what items of fisheries development were likely to receive financial assistance from the Central Government. The main consideration would be the suitability of the scheme for increasing substantially the food resources of the country within the next few years.

BAINI PRASAD, D.Sc., F.R.S.E., F.R.A.S.B., F.Z.S., F.L.S., F.N.I., M.B.O.U., is Fisheries Development Adviser to the Government of India.

All the items of the agenda were discussed fully and freely and 27 resolutions were adopted; a few of the more important ones are given below :

II. *Central Coordination of Plans of Development of Rivers*

As the problems of conservation and development of the fishery resources of rivers generally concern more than one Provincial or State Government, this Conference recommends that the Central Government should invite the concerned Provinces and States for each of the major rivers to begin with to confer and frame programmes and with their cooperation and assistance formulate joint measures for the conservation and development of their fishery resources as a whole, in order to ensure uniform methods of research, control and exploitation in all contiguous Provinces and States.

III. *Conservation and Development as Part of Multi-purpose Projects*

Since the conservation and development of the fisheries in artificial reservoirs, which will be constructed as a result of the large multipurpose projects throughout the Dominion, and the portions of the rivers likely to be affected by these reservoirs, is essential, this Conference strongly recommends that the Central Government in the Ministry of Agriculture should in consultation with the CWINC authorities, set up the necessary machinery for framing and implementing programmes of conservation and development of the fishery resources.

XI. *Development of Marine Fisheries*

As marine fisheries provide the largest and relatively untapped sources of fish supply, this Conference strongly urges the Central Government and Governments of maritime Provinces and States to take the following measures :

(1) Central Government should carry out extensive surveys for locating and charting fishing grounds.

(2) Central Government should carry out pilot experiments in off-shore and deep-sea fishing to test the suitability of different kinds of craft and gear for Indian waters and to determine fishing seasons, fishing intensities, etc.

(3) Central, Provincial and State Governments should take steps to improve harbour facilities at all important fishing centres.

(4) Provincial and State Governments should encourage local enterprise to undertake fishing by powered vessels fitted with cold storage facilities and other modern equipment.

XV. *Establishment of Indian Fisheries Research Committee.*

In view of the urgency of the need for research results and the necessity of utilizing staff, equipment and funds to the best purpose, the Conference considers it of paramount importance that effective coordination and integration of all research work relating to fisheries should be secured and, therefore recommends that an advisory body to be termed 'The Indian Fisheries Research Committee' be appointed by the Government of India with the object of formulating a comprehensive plan of research in the problem of Indian fisheries. For this purpose the Committee should undertake an immediate assessment of information relating to research in Indian fisheries conducted in the Provinces, States and Universities. The Committee should publish this assessment for the information of all Provinces and States and should also publish supplementary information as an when received.

The Conference recommends that the Indian Fisheries Research Committee should be composed of seven members nominated by the Government of India from among leading research workers. The Committee should have the right to co-opt members for specific subjects under discussion.

Two Committees were appointed, one for steering and drafting and the other for drawing up a programme for the collection of Fishery Statistics.

The resolutions passed by the Fisheries Conference are now receiving the active consideration of the Ministry of Agriculture and it is hoped that their implementation will bring about a systematic and rapid development of the fishing industry of India.

ASSAM

S. R. BAROOAH

THE Government of Assam has finally opened the Assam Agricultural College at Jorhat. The College has been functioning since 16 August 1948 with 30 students on the roll. To attract better type of students the College offers five scholarships, the Government offers two scholarships for 'war service' candidates, the Central Government one scholarship for a scheduled caste candidate and the North-East Frontier one scholarship for a student from that tract. The College is situated near the Agricultural Laboratory and the Experimental Farm of the Assam Government which will give plenty of opportunities to the students for study. The strength of the staff including the Principal is ten which will be increased as new classes are started.

This College will really meet a great need of the Province at a time when all are looking forward for rapid progress of scientific agriculture. In opening this College formally on 1 November 1948, Sir Akbar Hydari, the Governor of Assam, said that the Assam Agricultural College should establish a high standard in agriculture in all its forms and that the authorities should not lower the standard of the College so that in course of time the diploma of the College would be valued and recognized all over India in the practice of Agriculture. 'I hope' he said, 'that in course of time farmers will send their sons to this College not with a view to obtaining jobs in the Agriculture Department but with the object of returning to their lands and bringing to their cultivations improved methods. I am not one of those who decry the ancient agricultural practices. They are mostly based on hard experience, but just as in other productive fields, study and research add to the output and quality of production, so it stands to reason that the lessons of modern agricultural research can be applied profitably to this land even by small farmers.

'I hope that education imparted in this College will emphasize the fact that agriculture is something to be learnt in the fields and not in the class rooms and laboratories alone and adapt its institutions to conditions of climate and soil of Assam'. Sir Akbar concluded by saying that the Agricultural College which Assam was having would be yet another milestone in the path of development of the abundant resources of the Province.

The College is now teaching the syllabus which is meant to prepare the students for the Intermediate Science in Agriculture. By 1950 the authorities hope to start classes for the degree of Bachelor of Science in Agriculture. The College will be affiliated to the Gauhati University. To this end a Committee of Experts consisting of Dr N. R. Dhar, Professor of Chemistry, Allahabad Universiey, Rao Bahadur B. Biswanath, the Director of Agriculture and Development, Rajasthan, Dr J. C. Luthra, Principal of the College of Agriculture, Benares Hindu University, and Dr G. Lall, Biochemist, Indian Institute of Fruit Technology, Delhi, inspected the College. They will soon submit their report to the Gauhati University.

Rhea cultivation

Many inquiries and requests for cuttings of Rhea were received during the last few months. Cuttings were sent to a number of stations outside. And since we are growing this crop in our Experimental Station at Jorhat, I am giving a short note on this.

Rhea (*Boehemeria Nevea.* Hook and Arn) grows in Assam naturally. The fibres are used for making fishing nets. Rhea is propagated by slips which are planted in April after the first shower. Once this is planted it will grow for a number of years, as here it has been found that plants have been growing for more than 40 years. The crop is harvested twice during the period from May to October, when the stalks are about 5 to 6 ft. and when the lower leaves begin to dry.

The extraction of fibre is done by removing the outer layer of the bark by scrubbing the stalks with rough gunny bags. Then the stalks

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are dried in the sun for two or three days, after which the crude fibre is extracted by breaking the dry stalk at the base and pulling out the fibre. These fibres are then washed for cleaning and for use as ropes. This fibre crop needs improvement for better production, and also proper method of extraction should be found for getting better fibres for commercial use.

TRAINING COURSE IN PLANT PROTECTION WORK

WITH a view to increasing the number of trained personnel in fighting plant pests and diseases which cause substantial destruction to food-crops, the Government of India have arranged, as on last year, a combined course at Ajmer for training in Plant Protection, Inspection and Storage of the workers in Ajmer-Merwara and the Rajasthan Union. The course will start on March 1 and last up to March 18

The Plant Protection course will deal with the control of major insect pests and plant diseases of the Rajputana area, of which *Phadka* grasshopper, Red Hairy caterpillar and rusts and smuts of wheat, *jowar,* barley, etc. are the most dangerous.

The Inspection course will deal with the methods of inspecting foodgrains at various stages during storage, before despatch and at the destination.

The storage course will review the existing position of foodgrains storage in villages, large towns and cities and suggest measures of improving it. Proper methods of seed conservation against attacks of insects and diseases will be particularly explained. (*P.I.B.*)

Across the Borders

NEW RICHES FROM THE SOIL*

By WHEELER McMILLEN

THOSE who are searching hopefully for a major panacea to remedy the ills of the world will not be wholly satisfied by what they find in this book. Nevertheless they will find a prescription which, if sedulously applied, will effect more complete cures for economic and social ailments than the remedies applied so far by the statesmen.

Those who are concerned with means to accomplish such lesser purposes as the increase of employment in the United States and the stabilization, to some degree, of the nation's economy, will find a basic idea that may challenge their imaginations. Those who search for routes to a sound and prosperous agriculture will, I can promise, discover rather extensive areas of interest.

Since economic snake oils have never been so scarce as to need to be rationed, and since the meaning of the term chemurgy is not yet universally familiar, these broad assurances, qualified though they are, may seem entirely too sweeping to be credible. Without pausing to debate over that reaction, the immediate essential is a brief definition of chemurgy and some account of what it is all about.

Crops are renewable

So far as anyone can know, the forces of nature are not creating more iron or tin or petroleum, or any other of the minerals which man uses. When a ton of iron ore is scooped out of the crust of the earth, another ton is not put back in its place. When a barrel of petroleum is pumped to the surface, there is one less barrel in the underground reserves. When the mineral material is used it has disappeared forever from its original form, unless there happens to be some salvage value. The industry or economy which is dependent upon the mineral world operates with a species of raw material which not only is exhaustible but which also is irreplaceable.

Quite the opposite is true in the plant world. Most of the valuable plants of the earth are annuals; that is, they are sown, grown and mature within the period of a single year. Others are biennial, requiring a two-year space of time to achieve maturity. A few are perennial, like the alfalfa crop, which, once planted, yields frequent harvests over a period of several years. Among the fruit and nut trees from four to ten years may elapse before a crop is borne; therefore an annual harvest may be expected for the life of the tree. The longest plant cycle is in the forest, where from ten to fifty or more years must pass before a tree can be harvested for timber.

But whether the member of the vegetable kingdom is an annual, a biennial, perennial, or a tree, there is still the outstanding fact that it is reproducible.

Consequently those industries which look to agriculture and forestry for their raw materials have a constantly renewable source of supplies. If they consume annual crops, no matter what their volume of this year may be, the coming of next year's spring will start the replacement of the entire amount, and so on year after year into the future. If they consume a product with a longer cycle, the only difference is that it takes a little longer.

Resources of the soil

What difference does it make, some may ask, that an entire new supply of plant materials can be reproduced with each season of growth? Is not agriculture, too, an extractive industry in the sense of taking minerals out of the soil to make plant structure, eventually exhausting those minerals?

The answer is that the soil minerals, while vital to plant growth, contribute very little to the actual content of the vegetable material. On the average, ninety-eight per cent of the material in the plant, in the roots, stem, leaves and seed, is not the product of the soil minerals, but the product of atmosphere and moisture; air and rain, in other words, are transformed by the mysterious power of sunshine into the solid substance of the plant. About ninety-eight per cent of that substance is air and rain, whether the plant is a juicy watermelon or a solid oak tree.

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The minerals actually extracted from the soil contribute the other two per cent, or approximately the portion of the plant substance left in ashes after burning. In a few species the mineral content may run as high as five per cent. The elements principally required are phosphorus, potash, and nitrogen, along with minute traces of ten or a dozen others, such as copper, zinc, cobalt, boron, all usually present in sufficient quantities.

Phosphorus, potash and nitrogen are the three elements most generally purchased in fertilizers. Estimates indicate that the United States has enough phosphorus resources, if they are not recklessly used, to replenish the deficiencies in cultivated soils for many decades to come. We have a moderately adequate known supply of potash, and there are large quantities elsewhere in the world. Nitrogen is no longer a limiting factor, since abundant quantities can be extracted from the atmosphere at a cost low enough to permit its use in fertilizers.

Although not particularly pertinent to this point of the discussion, extremely pertinent to the whole topic of soils and plant growth is the fact that the soil is by no means merely a mineral or chemical structure. Scientists are only now beginning to place greater emphasis on the biological factors in soil quality. Earthworms, multitudes of bacteria, and perhaps other forms of life, are without question essential to the maintenance of a healthy soil in which organic matter, acting upon and reacting from the mineral characteristics, contributes towards creating the combination of factors, known and unknown, which join to produce a plant structure replete with the ingredients ideal for human use.

The emphatic fact at this point is that atmosphere and moisture are the principal raw materials out of which farmers produce crops. Obviously, the supply of air is without any conceivable limit. There is plenty of air. While water is not always abundant in the exact place and at the precise time when the crops need moisture, the total supply of water is ample.

Basic materials abundant

All this piles up to the monumental consideration that not only are man's plant resources constantly renewable and reproducible, but the primary materials out of which they are constituted are themselves the most abundant substances within the reach of man—the air and the water.

Consequently, so far as goods can be manufactured out of farm-grown materials, out of the vegetable kingdom, absolutely no limit can be set upon the production of new wealth, except the limits of man's own ignorance of the forces and materials with which he works. The more man learns about utilizing the wealth which grows out of the soil, the richer the world can be. This portends exactly as much for the future of the human race as the human race makes out of it.

Essentials of chemurgy

Farm chemurgy means putting chemistry and the allied sciences to work toward the greater industrial utilization of farm-grown materials. Conceived originally as an approach looking principally to the benefit of agriculture, the significance of the chemurgic idea has grown to national and international proportions, and has come to look far beyond the potential of agricultural good, great as that may be.

Agriculture is an ancient pursuit. Why hasn't chemurgy been considered long before?

The answer is that the tools for chemurgic performance have just recently come into view. Men have grown crops for centuries in order to eat the grain of the wheat and corn, the pulp of the apple, and to wear the fibre of the cotton, because no means existed for other forms of utilization. Foodstuffs had to be eaten raw or after simple mechanical preparation and cooking. Fibres could be used only if they were produced by nature in a reasonably convenient form for spinning, weaving or felting.

The three great new tools now available to agriculture, which make possible much greater enlargement of human wealth than ever in the past, are so new that even yet relatively little about their application has been realized.

The first of these is the science of organic chemistry.

The second is the science of plant genetics.

The third, which perhaps should be first, is the art of the engineer.

The engineer's role in chemurgy may be illustrated by the problem of utilizing cornstalks. Cornstalks are light, bulky, and widely scattered.

If men had first to cut and husk the corn by hand, tie the stalks in bundles, pitch them by hand on to wagons, and haul them with horses, and if the hand-tied bundles had then to be transported by freight cars from a country shipping point to a factory, the cost of the cellulose fibres in the cornstalks would be prohibitive for any industrial use now known. Other materials would be so much cheaper that the cornstalk would have no chance to be considered. The engineer's devices for chopping and baling the cornstalks into moderately compact bundles have made it possible to load one freight car heavily enough so that one small factory has utilized them for several years. Cornstalks from a limited area were collected and manufactured into wall board. The manufacturing problems involved are not too difficult.

However, not until further engineering advances are made, and not until cornstalks can be assembled in large quantities at a still lower cost, will they become an important industrial material.

While an engineering problem not yet fully solved delays the cornstalk's chemurgic triumph, it was an engineering success that lifted the soybean to agricultural and industrial eminence. Numbers of farmers knew how to raise soybean long before the crop became conspicuous. Planting and cultivation were fairly simple operations. Harvesting was difficult and expensive. The beans were usually cut by the grain binder and threshed by the threshing machine. Neither the binder nor the threshing machine did very good jobs with the beans. The whole method was cumbersome and expensive.

Then agricultural engineers came on the scene with the combine-harvester which had been developed primarily for the wheat fields. This machine, with simple adaptations, cut and threshed the soybeans with a single once-over operation that proved to be cheap and efficient. With the harvesting hurdle overcome, farmers did not hesitate to multiply their soybean acres when the commercial demand for the new crop offered a constant cash incentive.

Without the tractor, without the new types of farm equipment which only a tractor has power to operate, and without electric power on farms, a great deal of the present and future industrial utilization of farm crops would not be feasible. And, of course, without the engineering advances in transportation and manufacture, industry would not be in a position to operate the necessary processes.

The agricultural engineers have not only lightened and speeded the labour of transforming air and rain and sunshine into materials for human use, but they have lowered costs of doing the work so that many more materials are available at economic cost levels. Engineering has, in effect, introduced farm raw materials to the industrial chemist.

Aid from genetics

The function of the plant breeder is to induce nature to suit her objectives to the purposes of man. Plants are not always well-adapted to the requirements imposed by economic demands. Nevertheless they may be nearly enough suitable that the competent geneticist, skilled in obedience to natural law, can take advantage of nature's prodigality and persuade her to produce a plant which in characteristics or contents will conform consistently to an economic need.

It is enough to say here, in advance of the more detailed account of his achievements in other chapters, that the plant breeder is able to take a plant which is only moderately suited to the purposes industrialists or farmers may have in mind and produce a strain which year after year, if kept pure, will yield uniformly the desired shape and content. The geneticist's achievement may be attained simply by discovering, selecting and reproducing a strain with the desired characteristics, or it may be accomplished by complicated breeding operations conducted in accordance with a natural law which was not understood until the end of the nineteenth century.

Corn, cotton, soybeans and grain sorghums are among the plants which, responding to the plant breeder's art, have adapted themselves to specific industrial uses. So new is the art that countless plants which may have chemurgic values have not yet had time to receive genetic attention. Like the agricultural engineer, the geneticist is a new expert on the land. Their two arts, when associated with the science of the organic chemist, join to open up the entire new vista of wealth and well-being towards which chemurgy is reaching.

Chemistry in nature

A plant in the process of growing from seed to maturity, while picking out of the air and moisture and soil the elements which its growth transforms, becomes eventually a specific arrangement of atoms and molecules. The arrangement of the fibre in a boll of cotton is an extraordinary assortment of molecules so attached one to another as to constitute cellulose in as pure a form as nature creates that useful product. The fibres are attached to a seed, and the content of the seed is about nineteen per cent vegetable fat, or oil.

If cottonseed oil is subjected to a certain degree of temperature under a specific amount of pressure, and if this is done in the presence of nickel dust, an atom of hydrogen attaches itself to each end of the molecules of which the oil itself is composed. The oil then ceases to be a liquid at normal temperatures, and becomes a hard fat. Cottonseed oil, by this process, found a tremendous new market. American housewives as a rule do not like to cook with oil. They were long accustomed to using lard or butter. When they were shown that the hydrogenated cottonseed oil, used as a cooking fat, became rancid less easily than lard and was not so likely to pop hot particles out on their bare arms, millions of them abandoned the animal fats and adopted one of the commercial vegetable fats.

This is a simplified illustration of the tremendously dramatic science of the organic chemist. His business is the rearrangement of atoms, the building of molecules, and the understanding of these structural materials. Through his knowledge of several of nature's formerly unknown and still largely invisible details, he can turn to human uses materials which were never before usable for the new purposes, and often to purposes which never before existed. He is ceaselessly competing with himself, as witness the fact that other organic chemists have found means to improve the lard, which cottonseed oil largely displaced, so that it can be marketed without the old tendency toward becoming rancid, and without the old popping grease characteristic.

The organic chemist, it might be said, is the fellow who can start with the bag of beans which the housewife would bake or boil, and by subjecting them to tremendous temperatures and terrific pressures in the presence of his mysterious catalysts cause them to emerge as an automobile door instead of as a bowl of soup.

The organic chemist is always in search of materials which, with the least possible trouble and expense, he can transform into commercial products. The trouble and expense involved in making the silk purse from sow's ears was rather considerable. A more practicable method was devised when the long molecules known as polymers were studied and means were discovered to rearrange them on a commercial scale from air, water, lime and coal into the product known as nylon.

Nature, by her remarkably various achievements in plant life, has done a huge amount of the preliminary work for the organic chemist. When the chemist desires cellulose, he finds that nature, in growing cotton, wood and some other fibres, has gathered together large quantities of cellulose in forms with which he can work. The cottonseed, the soybean, and many other plants provide him with oils. Corn, potatoes, sweet potatoes, in the natural course of a season's growth, collect starch for him. Cane and beets make sugar. Large numbers of plants yield proteins from which the chemist can fashion items that appear so remote from the original soybeans or grasses that the transformation is truly fantastic; yet it works, it pays, it makes jobs, and contributes new things to the standard of living.

Like the plant breeder and the agricultural engineer, the organic chemist is new on the human scene. His science is little more than half a century old. Until it grew, chemurgy could not have been developed.

Other sciences, too, play important parts in chemurgy. The bacteriologist's knowledge of the microscopic creatures which cause fermentation is indispensable to the manufacture of industrial alcohols in the modern manner. The mycologist, who is master of moulds and fungi, is just emerging into dramatic importance because of his contributions to penicillin and streptomycin, which may be only the first of a number of new industries.

The search for peace

All over the world human beings long for plenty and for peace in which to enjoy it. Plenty has never been the lot of more than a tiny fraction of all those who have lived through all the unnumbered generations of mankind's existence on earth. The history of the centuries shows nothing more clearly than that peace always has been an exceedingly brittle and elusive jewel, easily broken and easily lost.

War is by no means a phenomenon of mere political behaviour. While the overt acts of aggression may be initiated by the personal desires of national leaders for their own political aggrandizement, and while a people may be propagandized into patriotic support for aggression, the basic causes of war are economic. Before aggression arises there is always a widespread national conviction of want or a national psychosis of envy.

Yet, although aggressive war has its roots in economic disparities, statesmen give far more thought to political than to economic preventives. Symptoms receive their study while the causes tend to be ignored.

The new scientific and practical knowledge of the more advanced peoples is adequate, if universally applied, to wipe hunger and want from the face of the earth. Man has the power, the machines, the knowledge of materials and methods, to produce plenty for all this world's two billion human bodies. The soil and the seas, the mines and the forests, contain the raw material resources to yield a world-wide abundance.

True, minerals and sunshine are unequally distributed. Even so, wherever masses of population are found, plant life is either abundantly producible or fairly accessible. New forms of transportation improve the mobility of plant materials. Chemurgy, dealing with these ever-renewable and inexhaustible raw materials, opens new routes to universal abundance.

Is it possible that on this seemingly narrow concept of new uses for crops and new crops to be derived from the earth's plant life, a new basis for peace among men might be built ?

The suggestion will bear examination. Perhaps one should approach it first from the viewpoint of one seeking peace and safety for his own country.

Crops for defence

Americans almost universally agree that the United States must maintain armed strength in the present chaotic world. No one doubts that the American influence for a future peaceful world can best be exerted if backed by capacity to wield force if necessary. Until a workable world scheme appears, the air forces, the army and the navy should be well maintained and the lights kept burning in the laboratories of destruction.

No lesson of the war was more sharply driven home than that the national defence reaches far behind the armed forces. The industrial production of the nation was its most powerful weapon. That production, in turn, depends upon ample supplies of the raw materials out of which war material is manufactured.

The United States was caught short on rubber. While this shortage was the most conspicuous, it was only one of countless failures to prepare on the economic front. The United States was short of scores of other commodities, and many of the shortages were exceedingly serious. Had the war continued longer, some of them would have been felt keenly in both military and civilian respects. Behind the scenes, strenuous efforts had to be made at huge cost to overcome shortages or to prevent the disasters that could have occurred had the war been protracted, had the submarine attacks continued longer to be successful, or had less shipping been constructed.

Millions upon millions had to be spent because the United States was short of hemp, flaxseed, kapok, castor oil, tung oil and scores of other agricultural items. The list was made up largely of the precise products which chemurgy had steadily insisted should be developed not only to occupy acres devoted uselessly and troublesomely to unneeded surplus crops, but because they might some day be vital to the national defence.

Farm-grown materials entered into the manufacture of every warship, airplane, cannon and tank built for the nation's armed forces, and into the fuel and the ammunition that were used. Chemurgy is an intimate factor in making the tools of defence.

But chemurgy's greatest opportunity is to help create the tools of peace!

All nations aided

Rubber can never again be the monopoly of any two or three nations. Synthetic rubber and new sources of natural rubber assure that. Motor fuel and aviation fuel need no longer be exclusive monopolies for any few nations. Those who do not have petroleum or for whom oil is too expensive, can obtain fuels from their carbohydrate plant materials.

Neither cotton nor silk can be of major importance as monopolies in a world that can make rayon, nylon and other synthetic fibres.

Iron and structural metals begin to diminish in importance when techniques are known that enable wood and plastic materials to perform their formerly exclusive functions.

Examples might be extended to a wearisome list, and all would add their weight of confirmation to a tremendously important chemurgic fact.

This fact is that the interchangeability of materials and the availability of more than one kind of material to perform a given basic function have vastly increased the potential self-sufficiency of all nations. Having done that, they have also vastly elevated the potential standard of living for the peoples of all nations.

Peace from prosperity

Take only a smattering of facts about standards of living in Asia and in Africa. Take only the few generally known facts about the soil, climate and natural resources of those continents. Who can doubt that the installation of modern power, modern machines, some modern transportation and agricultural skills could easily double the pitifully low standards of living on those populous continents? Double Asiatic and African living standards, by increased production of food and of goods needed in those great areas, and the effective demands there for the more advanced manufactured goods of Europe might well be doubled. The prosperity of three-fourths, if not of all the world, would rise markedly. Given evidence of a comfortable rising trend in living standards, the disturbed and unhappy peoples of the Old World poison spots would begin to settle into a state of contented progress. The rabble-rousing maniacs of the future would find far less welcome for their hoarse hatreds.

Is all this visionary?

Not so visionary as it is to put all human faith in the outworn abracadabra of traditional statesmanship!

In North America it has worked. The American standard of living speaks for itself. The Canadian standard, rising steadily alongside ours, has been a factor in the long peace and unfortified border, undoubtedly quite as effective as the natural and mutual ties between these two friendly nations. The people of each have never doubted their ability to produce wealth more easily and cheaply than either could gain an improved status by looting the other.

There is room for tremendous doubt over the ability of statesmen to create durable peace by their easily broken pacts and papers.

There is no doubt that human want could be enormously reduced by a universal concentration of effort toward the production of food and goods.

There can be little doubt that the relief of want and the consequent infusion of hope into the souls of men everywhere would fertilize the soil of peace.

The chemurgic concept

What stands in the way? If the whole human race can lift itself from want, why does it not forthwith proceed to do so?

Americans have done it. Their resources were not superior. To say that here a superior people were assembled is to flatter our native vanity but the assertion is neither provable nor polite.

The basic explanation and essentially the only one is that here individual freedom gave rise to economic leadership that saw opportunities in production. Government was the servant and never the master during the century and a half of American rise. Maybe freedom is a pre-requisite to abundant production. If so, then the areas of freedom must find ways to expand.

I have something deeper than a mere notion that if the thinking people of America and of a few other countries fully grasped the potentials of world-wide productivity and then raised their voices at home and abroad to extend their understanding, they might in no great time find themselves achieving a doubly great work—the humanitarian accomplishment of helping the less fortunate of the earth to help themselves, and the even nobler task of charting thereby a road that truly can lead to durable peace.

The chemurgic concept points out abundant new resources. The chemurgic sciences have shown how these new resources, the celluloses, oils, proteins and compounds of plant life, all inexhaustible and ever-renewable, can be converted into good things for humans to use. Plant-life resources are far more generously distributed over the geography of the earth than is mineral wealth. Nations with soil and rain and sun as well as nations with iron and gold and coal can become rich.

Isn't it time, then, that the rulers of men, the leaders of nations, woke up to the facts of modern productive science?

Isn't it time for leaders to arise who fully comprehend that far more wealth can be produced than can ever be stolen?—Reproduced from *Chemurgic Digest*, February, 1948.

FAO STUDIES CHIEF FARM COMMODITIES

BASED on a recommendation of the Fourth Annual Conference of the Food and Agriculture Organization attended by 58 member governments in Washington last November, a working party has been set up to study twelve agricultural commodities which enter into world trade extensively. The commodities are wheat (including flour), sugar, coarse grains, rice, cotton, fats and oils, coffee, rubber, wool, dairy products (chiefly butter, cheese and processed milk), cocoa and tea.

The working party is made up of the representatives of Australia, Belgium, Brazil, Canada, India, the United Kingdom and the United States. The party will report to the Council of FAO at its first 1949 meeting scheduled for June 13 in Paris. The Council, in turn, will make a report and recommendations to FAO member governments.

Opening the meeting, the Director-General of FAO, Norris E. Dodd called the working party 'one of the most important steps that FAO has ever taken.' Simply stated, Mr. Dodd said 'the purpose of the work of this group will be to translate all the previous resolutions about these commodity problems into positive and practical courses of recommended action'.

Matters to be considered for each commodity under review will include prices, quotas, scarcities (as with rice), homogeneity (a problem of particular importance in dairy products and fats and oils), interchangeability in use or in production, the effect of exchange difficulties and purchasing power on commodity agreements, and such measures as stockpiling and price schemes.—*Farm News, Canada*, February 9, 1949.

Home Gleanings

MECHANIZED RICE CULTIVATION IN THE U. S. A.

By S. K. MUKHERJEE

RICE is no stranger to the United States. The colony of South Carolina used to grow rice as far back as the 17th century. Along with Georgia they used to supply most of the rice needed in this country till the civil war in the middle of the last century, after which the acreage declined sharply as rice from Asia could be imported at less cost. A revival of rice growing took place in the late nineties when it was found that it could be profitably grown in the Prairies of the Southern States with machines like any other cereal crop. Since then rice has grown to be the chief cash crop of many of the countries of the States of Louisiana, Texas, Arkansas and Sacramen to Valley in California. Acreage under rice almost doubled during the last war to fill in the vacuum caused by the loss of Asian exports to West Indies. Now the United States is the chief supplier of rice to these Carribean islands. Internal market in the United States is not very large as the *per capita* consumption comes hardly to 2 to 3 seers per year as compared to 3 to 4 md. in rice eating countries, hence increase of rice area is not advocated until more permanent export areas are developed. Moreover, improved varieties have increased average yield per acre which is now over 30 maunds—about double of India's average. Strangely enough rice is not grown in this country in low-lying marshy land as popularly believed. It grows on irrigated level land of rather heavy texture with an impervious subsoil below. High temperatures averaging 70 to 80 F. prevail in rice areas throughout the growing season. In contrast to India most of the rice fields are at higher level than the highways and are provided with adequate drainage channels. Average individual rice field is about 50 acres but larger fields are preferred in more mechanized farms.

Rainfall in rice season is not adequate and it does not meet full water requirements of the crop, hence all rice crops have to be irrigated. Water is either diverted or pumped up by huge pumps from the various streams in these areas and distributed in surface canals by private-owned companies who charge about Rs. 30 to Rs. 40 per acre per season on the basis of the quantity of water used by the farmer. In a few areas irrigation water is obtained from tube-wells which are able to discharge at least six gallons a minute and these are mostly owned by the farmers. These pumps are operated either with diesel engines or electricity and cost of irrigation per acre ranges between Rs. 40 and Rs. 50 per acre. Most rice lands are level with gentle slope towards the drainage channels. A competent surveyor is employed to locate the supply, drainage ditches and field 'sieves' (bunds) which hold water of the field throughout the season. 'Sieves' are located permanently on contour lines dividing the land into sub-fields. Disc ploughs are employed to construct them and they are made with a broad base and gently sloping sides to allow farm machinery to pass over without any trouble. They are high enough after settling so as to hold 6 to 8 inches of water in the sub-fields during the season.

To prepare the seed-bed land is ploughed, disced and then harrowed and powdered by tractors with steel wheel with lugs or track layers. If the field is not level enough after all these operations a huge steel drag (henga) with wheels at the ends is drawn as a final operation prior to sowing. The fineness of the seed-bed depends on the method of sowing.

No transplanted rice is grown in the U.S.A. Contrary to the experience of all rice-growing countries of the world, experiments in the U.S.A. so far have indicated that no significant gain in yield is obtained by transplanting. Moreover, no suitable machine has yet been designed for that purpose. The older method of seeding consisted of sowing 1 to $1\frac{1}{2}$ md. of seed per acre with a grain drill or broadcasting with an endgate seeder like any other cereal in dry soil. This needed very fine seed-bed preparation, hence more time and labour. Fields used to be flushed with water for two to three days and then drained if the land had not enough moisture of germination. Fields were again flooded about two to three weeks after germination and gradually the level of water raised to 8 inches with the growth of the plants and held at that level till draining out just before maturity.

The latest method consists of sowing seed from airplanes in flood fields holding 2 to 4 inches of water. These planes fly about 10 feet above water and are fitted with special broadcasting chutes at the bottom both for seed and fertilizers. The width they cover in a run is indicated by men with flags at the edges of the field being sown. A plane can sow seed or fertilizer about 40 acres an hour at a cost of about as. 2 per seer of seed or fertilizer broadcast. Experiments have proved that better strands and better weed control can be obtained by seeding directly in water than dry land sowing. Moreover the seed-bed does not need to be worked up to so fine a state as in the other method. In fact in bigger farms airplane method of sowing and fertilizing has proved to be cheaper and quicker and has eliminated hazards of wet weather hold-ups at seeding time. Level of water in the fields is raised to 4 to 8 inches as seedings come up. This level, as in the previous case, is maintained with addition of water from time to time to make up the losses due to evaporation and other causes.

Heavy doses of fertilizers are applied in the dry seeding method at the time of sowing. With the plane method they are broadcast from air three to four weeks after sowing. The mixture of the fertilizers used depends on the local soil requirements but nitrogen and phosphorus are the principal constituents.

Latest method of controlling pernicious weeds in rice fields is by spraying selective weed killer, 2-4 D, from air at the rate of two to three gallons per acre. It costs about Rs. 10 to 15 per acre. This synthetic chemical is a selective weed killer. It kills broad-leaved weeds without damaging rice plants if sprayed after rice plants are over four weeks old.

Harvesting methods now getting obsolete consisted of the use of grain-binders drawn by tractors or horses. About 9 to 12 bundles were made into a stock and left to cure for a fortnight in the field. Then they were threshed with stationary threshers driven by belt pulley of a tractor. Average time taken was about 14 to 16 man-hours and 2 to 3 tractor-hours per acre for both the operation of threshing and harvesting. But the labour shortage problem during the war years saw the successful introduction of direct combining methods, which were being used in the wheat fields of Prairies for a long time. With minor adaptations like changing to tracklayers from rubber wheels, these combines either self-propelled with 14 ft. cut or tractor drawn 6 ft. cut, are now the mainstay for the rice farmer. Combine needs only one man to operate—the harvester and thresher in one operation. Thus there is no labour required for stooking the bundles. But the combined paddy gets no time to cure, hence it is very high in moisture content. It requires about 3 man-hours and 1 to 2 tractor-hours per acre. Usually combined rice is handled in bulk. From the combine tank paddy is poured into box trucks which deliver paddy to a drier or rice mill. On an average a 14 ft. cut combine harvests about 30 acres a day.

One of the obstacles in the use of combines has been the need of artificially drying paddy before it could be stored and milled, otherwise fermentation sets in due to high moisture content. It costs about Rs. 4 to 5 per acre to artificially dry paddy for a 30 maund crop. Total cost of production ranges between Rs.170 to 250 per acre depending on the season.

It would be of interest to know that the usual medium and long-grained rices grown in south U.S.A. are known as Patna rices. They fetch a premium over coarse-grained Japanese rices grown in California.

The principal factors which have contributed to high yield in the U.S.A. in spite of such extensive methods of culture are improved seeds, irrigation facilities, liberal application of fertilizers and rotation. Rice is usually grown every third or fourth year in the same field. The years intervening between two rice crops are used for grazing cattle by sowing down in pasture. In some localities a catch crop of soyabeans is taken in addition. Leaving aside mechanization, we could materially add to our rice yields in India and alleviate food shortage by adopting the above-mentioned methods.—Reproduced from *Indian Nation*, November 21, 1948.

Book Reviews

FARM MECHANIZATION HANDBOOK

By P. A. Reynolds (Published by the English Universities Press Ltd., for Temple Press Ltd., Bowling Green Lane, London E.C.1, 1948, pp. 182 and index, 8s. 6d.)

THE book under review consists of 33 chapters covering 182 pages plus a short introduction and index, 9 pullout diagrammatic illustrations and certain advertisements. It is profusely illustrated with photographs and line drawings which for the most part are excellent. It is written in simple easily understood language suited to those who are not highly trained in workshop practice or engineering.

The book is primarily intended for those concerned with the maintenance of power-driven machinery on the farms of Britain and nearby European countries. However, the first five chapters are of a general nature, dealing with the Farm Workshop, Workshop Equipment, Metals, Elementary Mechanics, Principles of Fitting. These give information of a general nature useful to those dealing with the maintenance of all sorts of farm tools and implements.

Chapter V is particularly useful in that it deals with simple tools and processes required for maintaining farm equipment. Each section is illustrated so that the explanation is clear and easily understood. These first five chapters are worth the price of the book.

Chapters VI to XIV inclusive deal with the principles of the various types of internal combustion engines and their maintenance and repair. These chapters are reasonably complete and deal with things the operator and maintenance man on a farm need to know. They have the minimum of unnecessary detail, are short and to the point.

Chapters XV, XVI and XVII deal with magnetos, dynamos, starter motors and batteries in the same direct practical way, giving the needed information in the simplest way.

Chapters XIX to XXV deal with the various parts of tractors and automotive vehicles including clutches, front axles and steering, gear boxes and rear axles, tractor brakes, tyres, tractor hydraulic systems and engine maintenance and repair. These chapters also seem to give the necessary information in the minimum space and with clearness and good illustrations.

Chapters XXVI to XXXIII again deal with miscellaneous jobs including blacksmithing, pipe work, farm water supply, overhauling a pump, belt transmissions, compressed air on the farm, electricity on the farm, storage of combine harvesters. These chapters maintain the previous excellent standard.

While much of the material dealt with covers matters which do not concern the ordinary small farmer, they are matters which are likely to concern those operating Government farms, large private farms where power equipment is used and those concerned with agricultural and rural institutions. It is an excellent little book for students in agricultural colleges to consult. While it does not have enough material to be considered a complete text book for such classes, it is an excellent reference book for college classes in farm shop work and farm machinery. I would strongly recommend it for the libraries of all Intermediate and B.Sc. Colleges of Agriculture as well as for the private libraries of Farm Superintendents, Agricultural Department officials of all grades and private persons who are interested in the use of power machinery and the larger animal-operated implements. (M.V.)

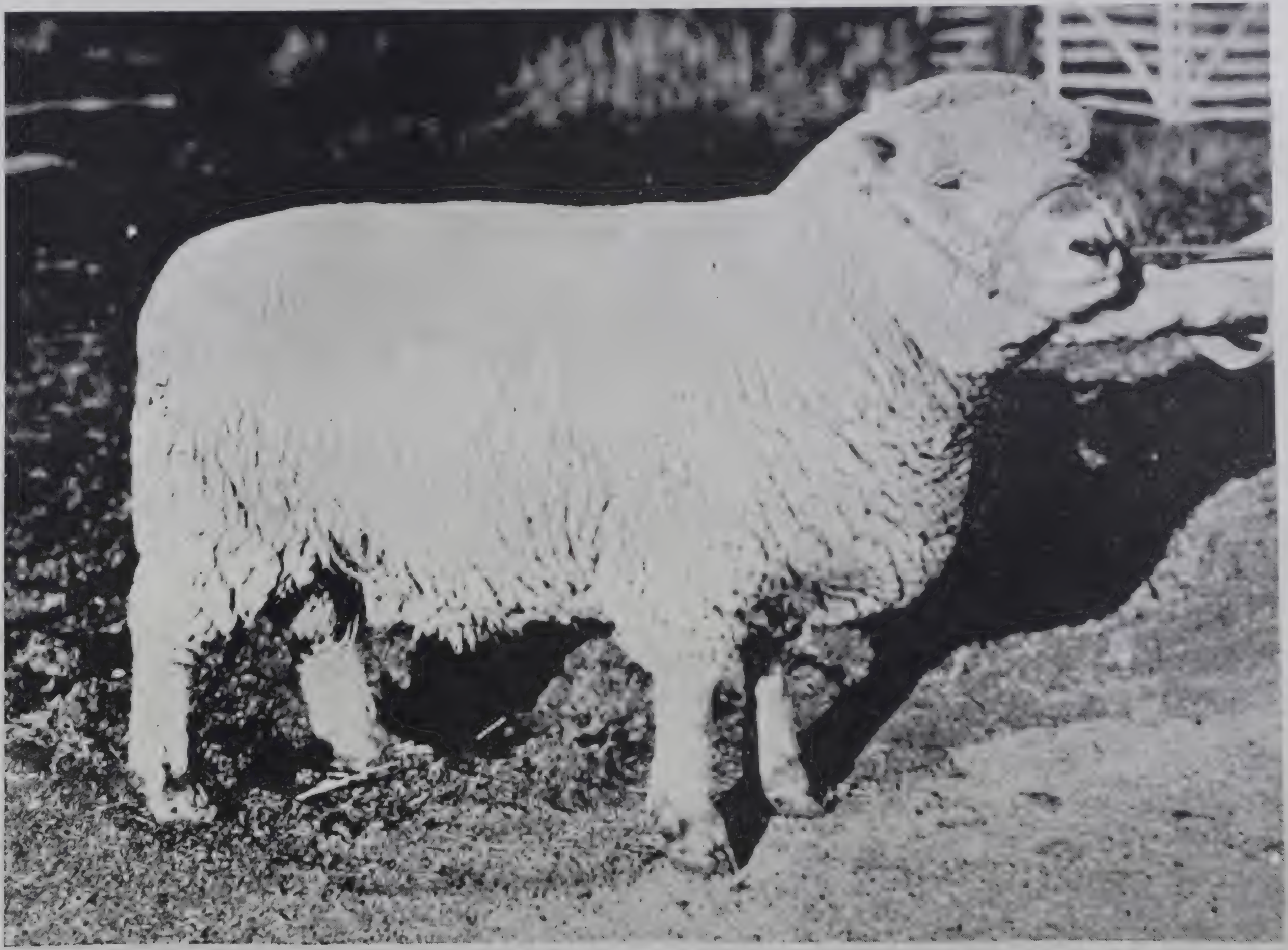

Fig. 1. A Southdown ram.

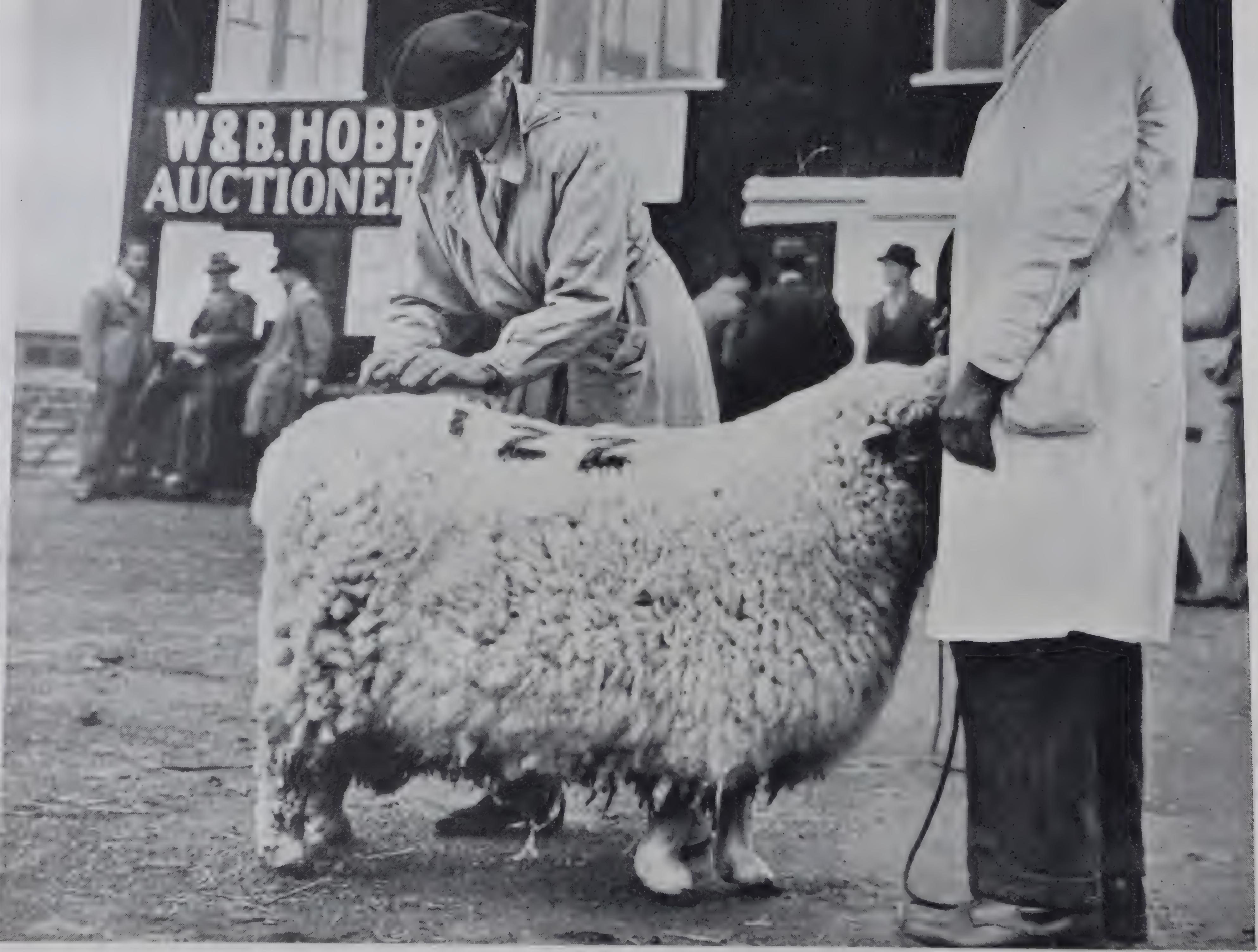
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Fig. 2. A Romney Marsh sheep

News and Views

BRITAIN'S DUAL-PURPOSE SHEEP

By JOHN HARRIS

ONE breed of sheep alone—the Lincoln—has sent 70,000 animals overseas in less than 40 years and when the development of new stock raising industries was at its height many thousand sheep were shipped from Britain every year.

The world sheep population has declined. That of Britain, now about 17,000,000, is 8,000,000 below what it was 10 years ago, having receded before the dairy cow and the plough during World War II. Nevertheless, some 2,000 head of pedigree sheep were sent overseas during 1947 and the British flockmaster is at present very export-conscious, ever seeking new markets. A feature of export trade in the past few years has been the participation of breeds that formerly were kept only in Britain.

Wherever sheep are used for the production of meat, stock derived from Britain's breeds will be found in abundance. Although the emphasis is on meat, it is, however, a fact that many of her native sheep are dual-purpose in that they yield also a good clip of wool. It must be remembered that even in Britain sheep were regarded primarily as wool producers until the turn of the 18th century.

Over 30 pure breeds

There is a wide variety of cattle and pigs to be found in the U.K. but even they are surpassed in this respect by sheep, for there are more than 30 pure breeds, apart altogether from the innumerable cross-breds which play such a large part in commercial production. It should, however, be noted that a number of these breeds are only to be found in relatively small numbers in their own particular locality. Here is a description of a few breeds representative of each of the three types into which British sheep are commonly classified.

First come the short-woolled sheep. They include the six well-known Down breeds, originally associated with the Chalk Downs. These breeds were the basis of arable sheep farming, but that has greatly declined in recent years and today they are spread all over Britain, the rams being much used for cross-breeding.

No breed anywhere can equal the quality of the Southdown for meat. In today's food shortage, quality has had to be sacrificed to quantity and the small Southdown has suffered. The Suffolk is one of the breeds going steadily ahead in Britain. The last 10-year average for lambs was 130 lambs reared per 100 ewes and this is a healthy, reliable breed. It is now more widely scattered in the U.K. than any other Down breed. The Suffolk is a great meat producer, the lambs weighing 80 to 90 pounds of lean dressed carcass at eight to ten months old. This is one of the breeds which have been imported by Italy since World War II.

Hampshire lamb

Another breed sent to Europe in large numbers recently is the Hampshire Down. A quick grower, it yields a splendid mutton carcass. In 1947 a Hampshire ram lamb was sold for 1,000 guineas (Rs. 14,000) and a number have been exported to the U.S.A. at very high prices. The other three Down breeds are Oxford Down, Dorset Down, and Shropshire. Oxfords are noted for big joints of high quality, three lambs being in the record book as having scaled 696 pounds in the days when food was plentiful. The Shropshire is less numerous in Britain than it was, but is prolific and remains one of the leading English breeds in the U.S.A.

Two breeds of the English-Welsh Border popular today are the Clun Forest and Kerry Hill. The Clun is one of the larger breeds in this classification, is hardy and has a reputation for fecundity. A percentage of 150 lambs per 100 ewes is frequent. This is probably one of the breeds of the future. The Kerry fulfils functions similar to the Clun, doing well on both upland pastures and lowland farms. Its white face, with black nose and perhaps black spots around the eyes, give this breed a striking appearance. Kerry Hill ewes are really excellent mothers.

Long-wool breeds

The second classification comprises the long-woolled breeds. These include the larger types of sheep and since they produce big joints, which tend to fatness, their popularity has suffered. Long-wool breeds, however, have a considerable part to play in cross-breeding and the ewe by a Long-wool ram out of a hill ewe, crossed with a Down ram, produces excellent lambs for fattening on grass. A famous example of this type of ewe is the Border Leicester Cheviot, or Half-bred, widely distributed on lowland farms throughout both England and Scotland. The Long-wool breeds have played a large part in the export trade; in September, 1948, 450 Lincolns were sent in one consignment to Eastern Europe together with over 300 Kents.

In 50 years 22,000 Kent or Romney Marsh sheep went abroad, chiefly to Australia, New Zealand and South America. Its wool clip averages eight or nine pounds and is finer in quality and denser than any of the other Long-wools.

The Leicester was the breed upon which some of the earliest and most successful improvement was done and it is one of the most firmly fixed types of British livestock. It produces a good fleece weighing up to 20 pounds for yearling animals. The largest British sheep is the Lincoln and it provides the longest fleece. Argentina has more Lincolns than any other type. No breed has been exported in larger numbers.

Mountain breeds

Lastly, we come to the mountain or hill breeds, with their ability to live on exposed mountain or moorland grazing. During the dreadful winter of 1946-47 the upland flocks of Britain suffered terribly and hill sheep farming has been adversely affected also by the reduction of lowland flocks due to the spread of dairy cattle and the ploughing of grassland. Nevertheless, there is a great deal of high land in Britian where only sheep can thrive and a special subsidy is paid at the present time to try and maintain the sheep industry in remote parts of the country.

The most numerous of the mountain breeds and indeed one of the most important of all breeds is the Scottish Blackface. It is wonderfully hardy and thrifty, in common with other hill breeds yields mutton of grand flavour, and is specially suited to heather-clad hills. Rams of the hill breeds made big prices and £2,000 (Rs. 26,666) was paid in Scotland for a Blackface in both 1946 and 1947.

Another leading breed is the Cheviot, at its best on the grassy hills of the Scottish Borders but having spread far and wide. Lambs straight from the grazing will weigh 30 pounds dead weight and again the flesh is of the highest possible quality. The wool of the Cheviot is used in the weaving of many of the famous Scottish tweeds.

Welsh Mountain

Wales, like Scotland, has an abundance of high ground and a particular breed has been developed—the Welsh Mountain. About the smallest British breed, it is remarkably active and hardy and will find a living on the bleakest hillsides. The meat is lean and is famous for its flavour.

Leading authorities agree that the quality of the best of Britain's sheep is as good as it has ever been. The industry has been through a testing time, but there has been some recovery in numbers in the past year and it is generally agreed that there is, and always will be, much land that can only be farmed to full advantage with the aid of sheep.

Breeds used primarily for controlling flocks of sheep in Britain include the Collies, the Old English Sheepdog and the Welsh Sheepdog. The rough coated Scotch Collie is very widely known and has gone into all parts of the civilized world. Weighing about 50 pounds, standing perhaps 24 inches, he has a long lean head and a profuse coat with fairly harsh outer hair.

Sheepdog trials

Collies are seen at their best at the summer Sheepdog Trials, which have been a feature of

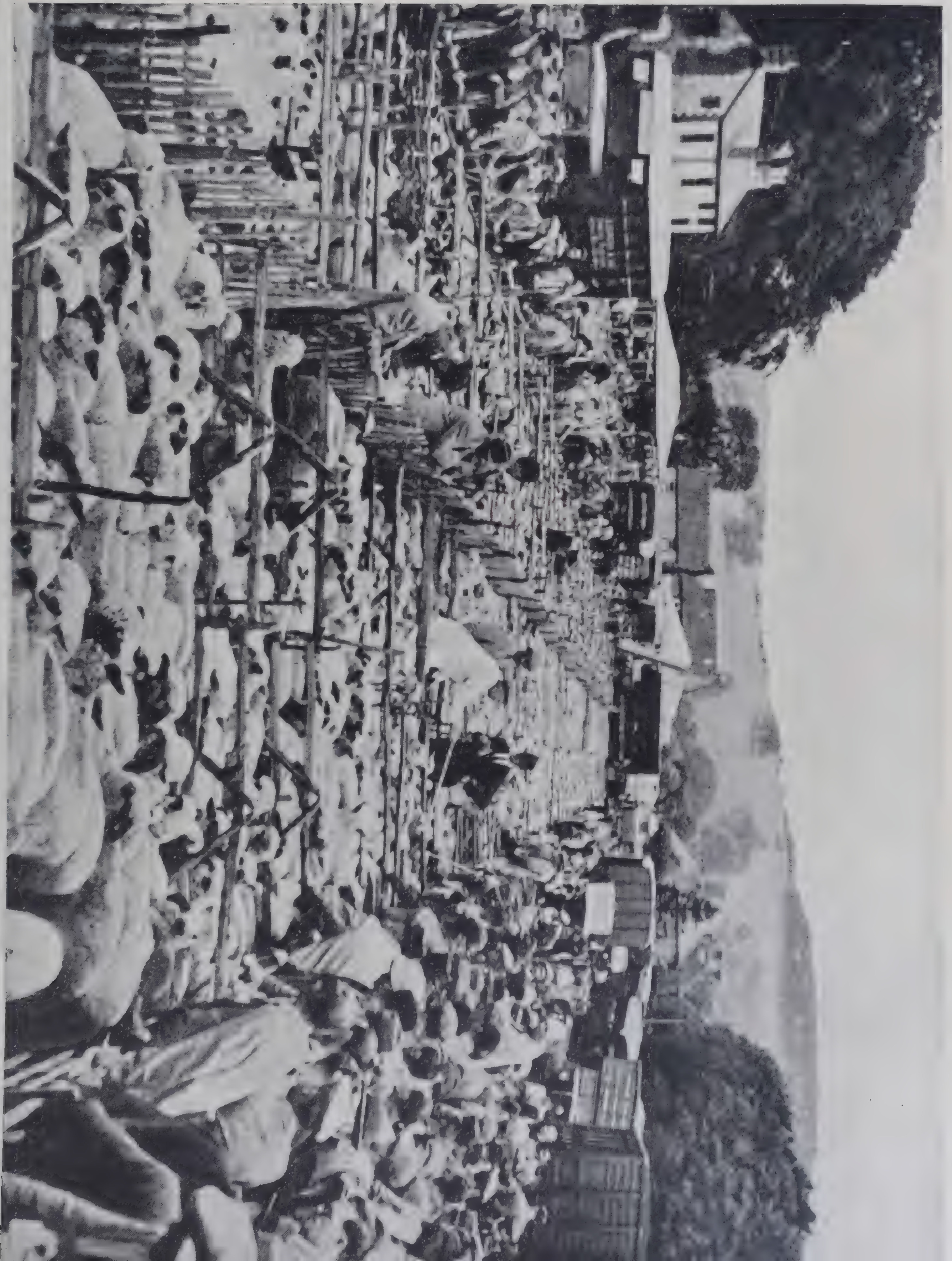

FIG. 3. A general view of the scene at the Findon Great Fair.

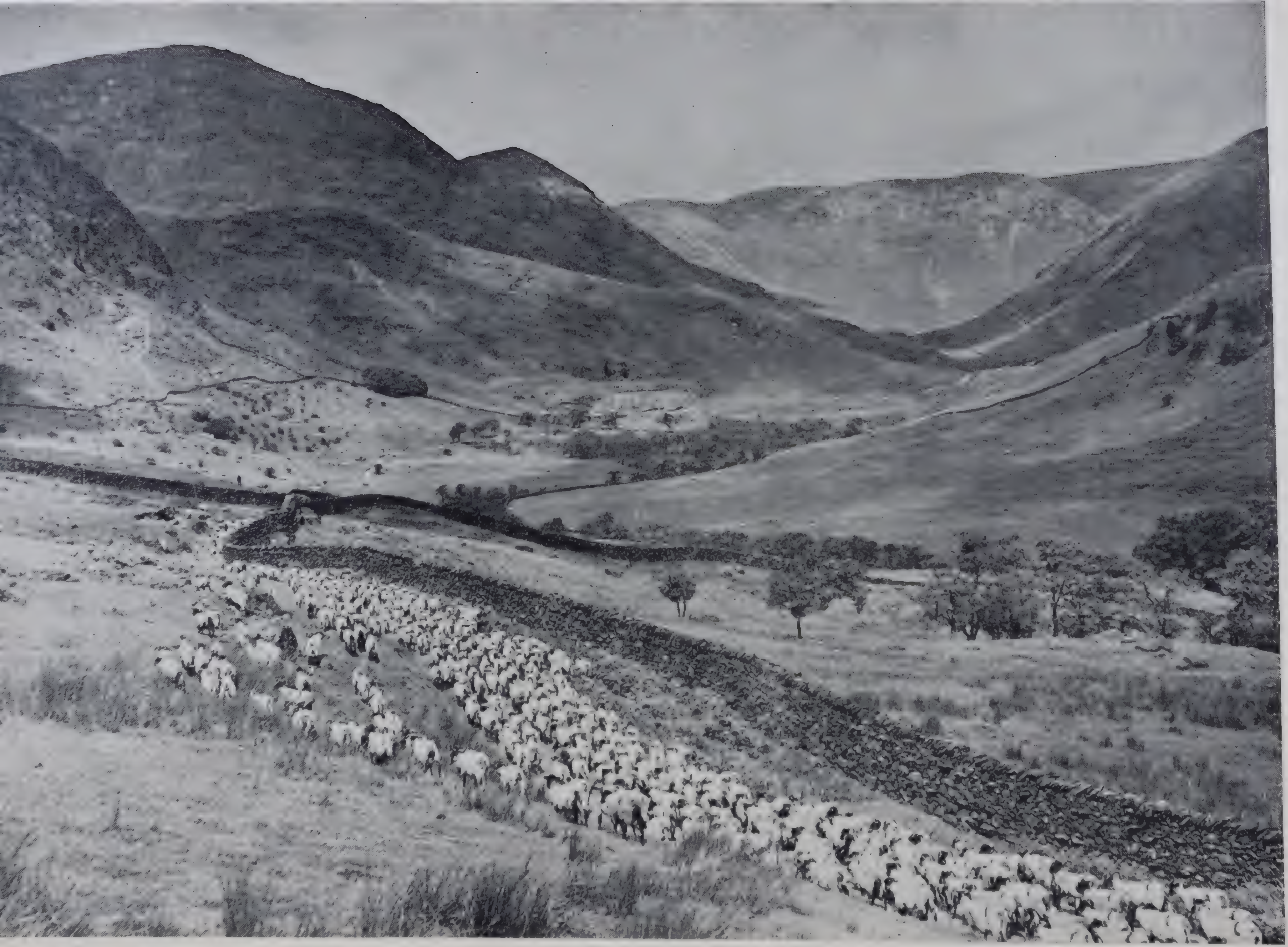

FIG. 1. A flock of sheep making its way back to the hills in Westmorland

Britain's country life since they were inaugurated in North Wales in 1873. The dog is required to drive strange, often wild, sheep round an intricate course and his ability to do so is most remarkable.

The Old English Sheepdog is also called the Bobtailed Sheepdog, as the tails are docked except in a small percentage which are born tailless. Standing two or three inches shorter than the Collie, the Old English is of about similar weight; his chief physical characteristic is the long shaggy coat and abundantly hair-covered head.

Throughout North and Central Wales is found the Welsh Sheepdog, a frequent and successful competitor in Trials and certainly unsurpassed in intelligence by any farm dog. He is not so pointed in the muzzle as the Scottish Collie (which may have been used in his development), the coat is smoother and the hair not so long. He weighs between 35 and 45 pounds and stands about 18 inches high. Another breed used on the farms of Wales is the much smaller Welsh Corgi. (*B.I.S.*)

ERRATA

Indian Farming, Vol. X, No. 1, January 1949 :

Page 10, column 1, line 25, *for* '1·5—1·75 per cent' *read* '0·5—0·75 per cent.'

Page 11, column 2, line 9, *for* '1 in.' *read* '1 foot.'

SUGAR TECHNOLOGY EXAMINATION RESULTS

THE following candidates are declared to have passed the final examination of the Sugar Courses of the Indian Institute of Sugar Technology held in October 1948. The names are in order of merit.

Short-term course

Chemical Control

1.	D. J. Yande	Second Division
2.	Abdul Salaam	Second Division
3.	B. B. Gairola	Second Division.
4.	Ram Bhajan Singh	Second Division.
5.	K. S. Mathur	Second Division.
6.	Hardit Singh	Third Division.
7.	C. D. Norman	Third Division.

Fuel Economy and Boiler Control

1.	R. A. Awasthy	First Division.
2.	Prakash Lal Chugh	Second Division.

Milling Plant Operation and Control

1.	Ram Gopal Misra	First Division.
2.	R. K. Tiwari	Third Division.

Pan Boiling

1.	Hari Shanker Dube	Second Division.
2.	Hari Raj Singh Tyage	Second Division.
3.	Z. Ahmed	Third Division.
4.	Parmal Singh	Third Division.

(I.I.S.T.)

COVER ILLUSTRATION

Prize-winners in the Sixth All-India Cattle Show held in Delhi in February 1947. In the picture may be seen 'Mudini' along with her daughter 'Pip' (centre) and grand-daughter 'Pipi' (extreme left). 'Mudini' is Sahiwal cow and triple winner of the Viceroy's Cup.

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Disease (Livestock) Investigation Officers' Conference, Mysore—14 to 16 February, 1949

PLATE 24

The Eighth Animal Husbandry Wing Meeting, Mysore—21 and 22 February, 1949

From Left to Right.—First Row (Sitting) (1) Mr. J. S. Garewal (2) Lt.-Col. G. V. Short (3) Dr. K. C. Sen (4) Dr. S. Datta (5) Dr. Z. R. Kothavalla (6) Mr. Clifford A. Taylor (7) Mr. H. C. Dasappa (8) Sardar Datar Singh (9) Mr. H. Siddiah (10) Mr. P. N. Nanda (11) Mr. S. M. Srivastava (12) Mr. P. M. N. Naidu (13) Mr. S. C. Das Gupta (14) Dr. P. S. Deshmukh (15) Mr. T. J. Hurley.

Second Row (Standing) (1) Mr. N. S. Sankaranarayanan (2) Major T. Murari (3) Mr. P. C. Banerji (4) Mr. V. R. Rajagopalan (5) Mr. S. G. Iyer (6) Mr. G. S. Godbole (7) Mr. S. L. Manjrekar (8) Mr. P. G. Pande (9) Mr. S. P. Deshpande (10) Dr. N. D. Kehar (11) Dr. H. N. Ray (12) Mr. K. Raghavachari (13) Dr. B. C. Basu (14) Dr. P. Bhattacharya (15) Mr. P. U. Nair (16) Dr. S. S. Prabhu (17) Dr. N. N. Dastur (18) Major A. C. Aggarwala (19) Dr. S. N. Ray (20) Mr. S. V. Mudaliar (21) Dr. K. P. Basu (22) Mr. K. J. Devadanam (23) Lt.-Col. H. K. Mehra (24) Dr. S. A. Jabbar.

Third Row (Standing) (1) Mr. P. R. K. Iyer. (2) ... ... (3) Mr. T. A. Padmanabhan (4) Major J. M. Lahiri (5) Mr. M. C. Rangaswamy (6) Dr. N. B. Tathwadhkar (7) Mr. Y. M. Parnerkar (8) Mr. M. Y. Mangrulkar (9) Mr. Dharamlal Singh (10) Mr. M. K. Patra (11) Mr. C. R. Sane (12) Mr. M. R. Dhanda (13) Mr. Harjas Rai (14) Mr. G. K. Mehra (15) Mr. S. K. Venkata Rao (16) Dr. S. Bose (17) Mr. V. R. Gopalakrishnan (18) Dr. N. B. Das (19) Mr. S. T. Patil (20) Sardar Balwant Singh (21) Dr. A. W. McClurkin (22) Mr. Habib Khan (23) Mr. G. S. Dehuri.

Fourth Row (Standing) (1) Mr. M. K. Srinivasan (2) Mr. Lakshmi Sahai (3) Mr. S. K. Bhadury (4) Mr. M. S. Palaniappa Mudaliar (5) Mr. Ramakrishnan (6) Mr. R. N. Mohan (7) Mr. N. P. Fernandez (8) Mr. R. L. Kaura (9) Dr. H. D. Srivastava (10) & (11) Messrs. Mitter & Sen (12) Mr. L. M. Thosar (13) Mr. Mahmoodullah (14) S. S. S. Bhatia (15) Dr. S. C. Ray (16) Dr. K. K. Iya (17) Mr. H. Laxminarayana (18) Mr. S. V. Chandiramani.

INDIAN FARMING

MAY, 1949

Vol. X No. 5

THE EIGHTH ANIMAL HUSBANDRY WING MEETING*

AS Chairman of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India, it gives me great pleasure to welcome you all to this eighth meeting of the Wing. According to the usual convention the meetings of this Wing are held every other year, alternately in Delhi and in a Provincial or a State capital. The last meeting which should have been held in Delhi was held in Lucknow in 1946. This year again it was Delhi's turn. But what has been Delhi's loss in this respect, has been our gain because we now have an opportunity to see this historic and beautiful city. Mysore, as you all know, is one of the most advanced States in India, as a result of the enlightened policy of her Rulers and their advisers. It is a land of immense natural resources and its buildings and gardens are famous for their architecture and beauty. It is the home of the renowned Amrit Mahal and Hallikar breeds of cattle which are so well-known to most of us here. Mysore has been a constituent member of the Indian Council of Agricultural Research for a very long time and has played an active part in promoting research in many fields of agriculture and animal husbandry. To mention only a few, we have the Sheep Breeding Farm at Yalachhihalli, the Sugarcane Breeding Farm at Mandya and the Fruit Research Farm at Hessarghatta all of which are subsidised by the Council. But more than all these, we have in this State two of the most important all-India Research Institutes, viz. the Indian Institute of Science and the Indian Dairy Research Institute which are located in Bangalore. The keen interest evinced by His Highness in scientific research and advancement has led to the establishment of yet another very important Institute in this State, viz. the Indian Institute of Food Technology, which is being set up by the Government of India in Cheluvamba Mansions, a magnificent building here, made available to Government through His Highness' generosity. The opportunity of meeting here is all the more valuable not only for these but also because we shall be able to see at first hand some monuments of the achievements of the State, for which a very interesting programme of excursions has been arranged by our hosts here.

Since we met last at Lucknow, there have been some changes in the constitution and membership of the Board specially as a result of the partition. I would specially like to mention the retirement of Major G. Williamson, the previous Animal Husbandry Commissioner, whose place has been taken by Mr P. N. Nanda. I would also like to express our genuine pleasure in having with us today Mr Clifford C. Taylor, Agriculture Attache of the United States Embassy, who has taken a very keen interest in the progress of Indian agriculture.

The two Wings of the Board of Agriculture constitute a forum where scientists interested in agriculture and animal husbandry gather together annually for a full and free exchange of ideas. These meetings afford a unique opportunity not only to understand the work done in the different parts of the country but also to solve various difficulties by mutual consultation and to lay down plans for the future. In this connection, I must refer to the Disease Investigation Officers' Conference, which was held last week, where active research workers on animal diseases have had a similar opportunity to discuss and exchange ideas. These conferences of research workers have been found to be very valuable in the past and the Hon'ble Minister for Agriculture in the Government of India is particularly anxious that such periodical conferences should be held to enable research workers to have the fullest benefit of the work done all over the country and to express their views. Accordingly it has been decided that in future, both in the field of agriculture and animal husbandry, such specialists' conferences will be held as a regular feature not only in conjunction with the meetings of the Board of Agriculture, but also at other times whenever suitable opportunities occur.

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*Speech of Sardar Datar Singh, Vice-Chairman, Indian Council of Agricultural Research and Additional Secretary to the Government of India, at the Plenary Session of the Animal Husbandry Wing meeting of the Board of Agriculture and Animal Husbandry in India held at Mysore on 21 and 22 February 1949.

Among other matters of a general nature, I would like to mention two recent decisions of the Indian Council of Agricultural Research in which you will be interested. The first one is regarding the organization of research work on a regional basis in India. Experience has shown that the lack of any rational system of planning research work has largely led to duplication and waste of effort in various respects and the Indian Council of Agricultural Research has recently decided that a certain measure of regionalization should be attempted purely as an experimental measure, for financing research schemes in future. In general, the idea is to divide problems into fundamental, regional and local—fundamental problems being tackled by Central Institutes and Universities; regional jointly by the Council and Provincial Governments and States; while purely local problems should be left to be tackled solely by the Provincial Governments and States. It is well-known that regionalization on a scientific basis is not possible without having complete data regarding the soil, climate and various other factors affecting production, but in so far as it has been possible, on the basis of existing information, the Council has decided that the country should be divided into certain distinct regions based on the predominant crops, animals and soil conditions in those regions. So far as animal husbandry is concerned, the country is divided into four regions—while the number of regions on the agriculture side is five. It is proposed to give effect to this system immediately and Regional Committees are being constituted for the purpose. These Committees will be meeting shortly for examining the various new research projects which have been approved by the Council, with a view to plan them as far as possible on a regional basis. I hope several of you who belong to Provincial and State Departments of Agriculture and Animal Husbandry will have an opportunity to serve on these Regional Committees. The second point which is of special interest is the fact that we have decided to insist on the presence of the actual research workers in the Scientific Committees of the Council, when proposals for research work or progress reports on running these schemes are considered. Such a procedure would make it possible for the Committees to understand various problems better and at the same time enable the research worker concerned to know exactly the views of eminent scientists on the progress of the work, which will be of use to him in the course of his investigations.

The division of the country in August 1947 has affected our position in regard to agriculture and animal husbandry to a very great extent. We are concerned here primarily with the question of how far our cattle wealth has been affected by the partition. I cannot but recall at this juncture the great interest evinced by the Father of the Nation, Mahatma Gandhi, in the welfare of our cattle population which has ever been a source of inspiration and encouragement to us in this country. As you are aware, Pakistan cattle belong to the well-known breeds of Red Sindhi, Tharparkar, Sahiwal, Dhanni and Bhagnari. The first three breeds have been used extensively in India either as pure breeds for milk production or for the grading up of local inferior cattle in backward areas of the country like Assam, Bengal, Bihar, Orissa and the West Coast of Madras. Although, we can still get a few animals of these breeds the supplies are limited and their procurement is hedged round by complicated conditions of inter-dominion trade agreements. We are, therefore, compelled to depend more and more on our own resources, to develop which extra effort is necessary. A note on this subject has already been circulated and I commend the suggestions therein for your special attention.

Though separate and complete figures are not yet available for the two divided parts of the country, it is still possible to indicate broadly the general effect of the partition on our resources of certain food products with which we here are concerned. Such data as we possess have shown that about a third of the total cattle population has gone to Pakistan. The average quantity of milk available per head of human population was 5·5 oz. a day in undivided India. The corresponding figures for India and Pakistan now are 5·2 oz. and 6·8 oz. It is necessary, therefore, that we take up cattle improvement work with redoubled vigour. Speaking of milk and milk products, the imports of milk products into India are rapidly increasing in volume and value. It is observed that between 1945 and 1948 the annual imports of butter have increased from 139 cwt. to 11,635 cwt. in quantity and from Rs. 23,196 to Rs. 23·9 lakhs in value. Similarly imports of cheese in 1947-48 were valued at Rs. 15 lakhs against 7·9 lakhs in 1946-47. Condensed and preserved milk accounted for Rs. 202 lakhs in 1947-48 as against Rs. 38 lakhs in 1945-46. This sudden increase in the imports of milk products indicates that this country, in spite of its enormous cattle population of undoubted potentialities, is unable to produce its requirements of milk and milk products. It should be our endeavour to develop our cattle in such a way as to enable them to supply at least half the minimum nutritional requirements, viz. 8 oz. per day per head of human population.

In this connection I wish to refer to one subject which I consider to be of far reaching importance, viz. the establishment of key villages for improvement of cattle in all the breeding tracts of India. The more I think about the complicated problem of livestock development, the more is the conviction forced upon me that such a scheme is the *sine qua non* of success in the economic exploitation of cattle in India. As you are aware these key villages are intended to be compact areas where concentrated work can be carried out under proper control and supervision and continued for years. According to a rough calculation a network of 625 key villages spread over the whole country will serve the purpose of producing superior livestock for improvement in the country at large. These key villages are meant to be real laboratories where the various measures proposed for animal husbandry development can be introduced and worked and where the results can be properly watched. It would not be practicable to take up the whole country in the scheme but we hope that the improvements will radiate from the key villages and spread into the country on an ever-widening scale. By adopting this method we should be able to cover the whole country with improved cattle in the course of 15 to 20 years which will give more milk and better bullocks.

When we run through the agenda we find that the subjects cover almost all the different aspects of animal husbandry development in India. The notes contributed by the various authors contain a number of recommendations for solving one problem or the other. We have had similar recommendations at our previous meetings as well, but if we go through them we will find that many recommendations have either not been given effect to or have not borne any fruit. The reason, as far as I can see, is that these recommendations have only been generally adopted but have not been introduced in specific areas where the results can be observed and measured.

To an assembly of this kind I need not point out that the great objective of livestock improvement cannot be achieved by concentrating attention on one or the other aspect, howsoever careful that attention may be. We have to tackle the several problems simultaneously. The various recommendations contained in the notes like the investigations of diseases, use of biological products, effect of trace elements, introduction of artificial insemination, production of bulls and cows of high efficiency, increased output of fodder and other cattle feeds, etc. are all matters which can very well be tackled in key villages if they are properly planned, staffed and equipped.

I do not wish to take up much of your time in enlarging on any other topic. Coming to the business of the day, you will find that the various subjects which we have on the agenda have been gone into very thoroughly by Special Committees, whose reports are before you. These subjects will be considered here in the light of the reports of the Committees and we may all look forward to a very interesting and useful discussion and decisions during the next two days.

It is needless to say how deeply grateful we all are to His Highness for very kindly agreeing to inaugurate our meeting in spite of all his other engagements. We are also grateful to the Hon'ble Minister for Finance and the Hon'ble Minister for Agriculture for finding time to attend. I know how very busy they are and it is really kind of them to have come down from Bangalore for this conference. It shows how deeply interested they are in our work.

I must also express on my own behalf and on behalf of all of you our deep appreciation and sincere thanks to the Government of Mysore for the excellent arrangements made for our meeting and for making our visit so comfortable and profitable. The burden of making these arrangements has naturally fallen on Dr Naidu and his officers to whom we are all greatly indebted.

May I, now, invite Your Highness to inaugurate the deliberations of this meeting. I hope that Your Highness, the Hon'ble Ministers and the other distinguished officers of the State who are present here will find it convenient to spare some time and take part in our deliberations.

Professor Birbal Sahni, M.A., D.Sc., Sc.D., F.R.S.
1891—1949.

(Courtesy of *Current Science*)

PROFESSOR BIRBAL SAHNI

AN APPRECIATION

PROFESSOR Birbal Sahni is no more. He died at midnight of 9 April, 1949, at Lucknow after a sudden heart attack. He was aged 58 years at the time of his death and is survived by his wife, Mrs. Savitri Sahni.

The death of a savant like Professor Sahni is unfortunate at a time when the country is in need of proved scientific talents. Professor Sahni's death is all the more poignant as it took place only a few days after Pandit Jawaharlal Nehru had laid the foundation stone of the Institute of Paleobotany at Lucknow of which he was the Founder-Director.

Professor Sahni was the third son of Professor Ruchi Ram Sahni, a distinguished educationist of the Punjab, and was born on 14 November, 1891, at Bhera, Punjab. Coming as he did from a highly cultured family, Professor Sahni seemed to have imbibed at an early age his father's keenness and enthusiasm for science. While a graduate student at Government College, Lahore, he came under the influence of Professor Shiv Ram Kashyap, the father of the Indian botany, under whom he began his studies in botany. Later on, in 1911, he joined the University of Cambridge, where he was initiated into the mystries of higher botanical research under inspiring guidance of Professor Sir Albert Seward, the noted Fossil Botanist, who was Professor of Botany at the University and later rose to be its Vice-Chancellor. He became a foundation scholar at Cambridge and later a member of the Emmanuel College. His researches in plant morphology won for him the Degree of Science of the University of London.

On his return to India in 1919 he joined as Professor of Botany in the Hindu University, Benares, but soon went over to the Punjab as University Professor of Botany at Lahore. He came to Lucknow in July 1921 as Professor of Botany and ever since continued his association with the University of Lucknow. In 1943 the University of Lucknow began courses of instruction in geology and he was appointed the Professor of Geology as well. During his long stay at Lucknow he successfully organized a very well-equipped laboratory and, in addition to normal teaching, guided the work of post-graduate research students and eventually organized a School of Botany. For several years in succession Professor Sahni was elected Dean of the Faculty of Science of the University of Lucknow.

A brilliant botanist that he was, Professor Sahni's earlier researches covered a wide field but later on they were restricted to various paleobotanical problems. He was probably the first to study and create interest in fossil plants in this country. It is obviously outside the scope of this note to indicate even in outline his researches and interests in the field of botany or paleobotany. The investigations and studies carried out by him and his students have thrown a flood of light on many obscure problems concerning the origin of important plant groups, the distribution of fossil flora and even the nature of geological formations.

Professor Sahni was intimately connected with a large number of scientific bodies both in this country as well as in foreign lands. He was the founder of the Indian Botanical Society and was its ex-President. He also edited the journal of the Society for many years. He was elected President of the Botanical Section of the Indian Science Congress in 1921 and again in 1938, of the Geology Section in 1926, and he was made General President in 1940. He was a Fellow of the Royal Asiatic Society of Bengal and Fellow of the National Institute of Sciences of India. He had also been the President of the National Academy of Sciences of India. He was the Vice-President of the Indian Academy of Sciences and the National Institute of Sciences of India. He was also Vice-President of the Paleobotanical Section at the 5th International Botanical Congress held in Amsterdam in 1935 and represented India at the third centenary celebrations of the Natural History Museum in Paris in the same year. He was connected with the Indian Council of Agricultural Research almost ever since its inception.

Professor Sahni was elected a Fellow of the Royal Society of London in 1936 and in the same year was awarded the Barclay Medal of the Asiatic Society of Bengal for research in biological sciences. He was deputed by the Government of India to tour the research laboratories in Europe, the United Kingdom and the United States in order to observe their organizational set up and working. He was elected Honorary Chairman of the 7th International Botanical Congress to be held at Stockholm in 1950.

He devoted his entire life to the cause of scientific research so much so that he donated his entire fortune, his large collection of literature and fossils to the Institute of Paleobotany which he established in Lucknow in 1946. This unique Institute is the first of its kind in the world. The foundation stone of this Institute, as stated before, was laid by Pandit Jawaharlal Nehru a few days before his death.

A tall, well-built figure dressed in *khaddar*-stitched *achkan* and Gandhi cap, he carried an atmosphere of friendly assurance wherever he went. Those who have come in contact with him can never forget his charm of personality and manners. Kind, sympathetic and sincere, he was a great scientist no doubt but he was even greater as a man. Students who have worked under him and his co-workers have always sought opportunities again and again of coming in contact with him and drawing fresh inspiration from him. One of earliest persons of India to take seriously to scientific research, his students are now occupying prominent places in Universities and Government Departments. He had a rare gift of speaking on abstruse subjects and explaining them in simple language. Whether he was addressing a sophisticated audience or talking to an assembly of uninitiated under-graduates on the 'floating continents', he always carried conviction and could always make his point of view understood and appreciated.

It will indeed be sad to miss the familiar figure gracefully bent over the microscope and explaining to and discussing with his students and co-workers difficult and obscure points of research. No longer will he be seen moving, calm and serene, among the crowded assemblies of academicians or in the colourful gatherings, on the occasion of some social events, in gray quadrangles of University colleges.

His was the life devoted to the cause of scientific research. To him indeed science was a passion and scientific pursuit a faith. So much indeed was science close to his heart that at the time of his death, the last words he uttered to his wife were 'Please nourish the Institute'; the reference was to the Institute of Paleobotany which he founded. (U.N.C.)

Original Articles

SCOPE AND METHOD OF RESEARCH AND TEACHING IN AGRICULTURAL ECONOMICS IN INDIA—I

By T. G. SHIRNAME

THE scope of agricultural economics is very wide and it extends from the individual producer to the social and national policies, attitudes and reactions towards agriculture. The task of an agricultural economist, therefore, must lead through the various economic operations involved in the production of farm commodities till these commodities reach the final consumer or manufacturer whose preferences and economic circumstances, in turn, cannot be ignored as factors influencing the type and volume of production. The organization of agricultural economic research and teaching must, therefore, begin with the individual farm, and after going into detailed consideration of the effects of political, social and economic statesmanships and institutions, as well as the effects of consumers' preferences and organizations, influenced through markets on agricultural production, must come back again to the individual farmer for the readjustment of his farming business. The work of an agricultural economist is thus very wide, much wider than is ordinarily thought of.

Object of the study of agricultural economics

It is sometimes claimed that the problems of agricultural economics arise very largely in connection with products which are produced for sale in the market. This is, however, a short-sighted view and the chief object of economic study in agriculture should always be to aid the farmer to adjust his farming business in a manner as will enable him to get the maximum for his efforts. It is not the improvement of market enterprises but it is the improvement of his economic and social status and his living which should be the aim of agricultural economics.

Farm management

The logical procedure of discussion of scope and methods of agricultural economics will, therefore, be to start with farm management. Under farm management the chief aim should be the study of the factors in the internal management of the farm which determine the productivity of the enterprise and the remuneration of those engaged in it.

Besides its use to the individual farmer and his immediate locality, farm management data will be a sort of background for any national programme, especially in planning out shifts in agriculture. It is not infrequent that national policies are misdirected in the absence of this background. Apart from the study of individual farms, the main object of farm management study will be to get an organized data which will enable each individual farmer to compare his own organization with the average as standard or with the abnormal or distinct as indicative of line of progress or adjustment. Each individual farm is a complex dynamic organization made up of distinct enterprises adjusted in such a way as to make the whole business run smoothly. Each of these different enterprises will have to be studied to determine their individual efficiency in the organization as also the proportions and distribution of the factors of production—land, labour and capital—which may affect the efficiency of the farm as a whole. Note is

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also to be taken of the fact that the combination of proportions is one thing, the form of embodiment of capital and the form or type of labour is another. In suggesting readjustments on individual farms, account will have to be taken of the change in economic conditions and this will perhaps be the most difficult part of farm management study and advice.

Marketing

After the farmer has produced his crops, the next step will be the disposal of the produce and this should be the next stage in agricultural economic research and study. It is here, at the time of disposal of his produce in the market, that the farmer comes in contact with the outside world and many general and social influences are exercised on the farms through the markets. It may, however, be mentioned that the question of marketing is not equally important on all the farms. In fact, in systems of peasant farming, it forms a small part. On the other hand, where farming is organized for production of commodities for the markets, the methods of sale and distribution have an important function in determining trends or policies of production. As such, the greater part of the time and energy of a student of agricultural marketing will have to be devoted to crops produced for the market. Besides the general conditions under which the produce is taken to the market, the teaching and research should embrace the study of the efficiency of the agencies and mechanisms through which the produce ultimately passes to the final consumer and the study of the factors and forces which lie at the back of the determination of the price of the product.

Other factors

The third field, which may be called the social economics of agriculture, is perhaps the widest branch of agricultural economics. Under this, the research will mainly concern with the study of the external factors which determine the course of production which is possible or desirable and those which determine the prices of farm produce and influence the distribution of income. This study of the external factors will include historical studies of long time shifts and trends of production and consumption, geographical studies showing the resources of and shifts in agricultural production, rural population studies, community and rural social development, rural living, land economics including public land policy, land values and land taxation, agricultural credit and credit institutions, farm mortgages, national policies, especially in connection with tariff in relation to agriculture and development of agricultural production, transport facilities and their influence on rural development and others.

Farm management research

Farm management concerns with the conditions affecting individul farms and as such is a branch of *private* economics. In its applied aspects farm management economics seeks to show the individual, or the group, how he or they can make the highest incomes. It is, thus, a study of the conditions of economic welfare of the individual farmer or his group. Farming is not only an art and a science but it is also a business and the successful farmer is a business man. Farm management is, therefore, a study of the conditions affecting the farm with respect to the land, labour and capital on the one hand and market and other external conditions on the other, with a view to forming decisions in regard to the selection and combination of enterprises as well as the efficient use of land, labour and capital. As such, farm management research has two functions. First, to increase the efficiency of the individual factors of production and second, to increase the efficiency of their organization and management. These two functions are not always independent, but one may be the result or cause of the other. The purpose of farm management research is to find ways and means of increasing efficiency and in order to do this properly the research must tackle the problem in a manner which will appeal immediately to individual farmers. Mere theoretical conclusions will very rarely attract a farmer. What he needs is actual practical demonstration of theory on his own farm or, less preferably, on farms in his near neighbourhood.

Layout of the farm

Perhaps the first consideration in the study of farm organization is the suitability of the layout and equipment of the farm. However hardworking, intelligent and well-equipped a farmer may be, his labour and capital will not return adequate yields if the land which he farms is unsuitable. Among the factors which determine the suitability of the farm for profitable cultivation, the size, shape, form, compactness of holding and the location of farm buildings are the more important ones. There cannot be one size optimum for all the time and places, but it may, however, become possible to determine for each type of farming one or a few sizes which will give maximum results over a period of time under the existing and expected conditions of capital, labour and demand. In a country like India where land supply is limited, the rural capital scanty and shy and labour relatively immobile, there is little scope of increasing the physical size of farm except at an exorbitant cost. The problem, then, becomes one of discovering the best combinations of the existing supplies of land with the existing supplies and conditions of the other two factors.

Although, there is less immediate possibility in Indian agriculture of increasing the area of farms to the optimum size except when advantage is taken of cooperative cultivation, it is well-recognized that there is a great opportunity for increasing efficiency, if farms were made of compact blocks, of suitable shape and form and with farm-houses suitably located on the holdings. Farming land in one block is conspicuous by exceptions in the most parts of India. Holdings are usually scattered, the distance between fields cultivated by the same farmer may be sometimes some miles. The shape of individual fields is anything but regular. Excepting the irrigated fields and lands which are required to hold a considerable quantity of water for their cultivation, as for instance the rice-lands, the fields are usually uneven, unembanked and unfenced. Among the advantages claimed for small farms possibly the chief, from an agricultural point of view, are that the farmer stays on the holding, supplements capital with his own labour and that of his family and that the cultivation reaches a high degree of intensity. Wherever natural conditions especially in connection with irrigation and transport are favourable and where a fairly large part of the holding is in one block, the farmer does stay on the holding and cultivates to a very high degree of efficiency. But, this is anything but common. Most of the farmers live within the village sites and there are places and times when farmers visit the fields only a few times during the year, sometimes only twice, once for sowing and once for harvesting if there be any crop to gather! There are no data in any part of the country to calculate the loss of efficiency resulting from these causes, but it must be enormous. Simple problems of research like the labour hours per acre on a given crop at various distances from homes, ratio of *walking time* to *actual productive work time* at various distances, application of fertilizers (if any) at given distances, yields (a) per acre and (b) per time unit of labour (walking plus working) at various distances, etc. will furnish a valuable information on the loss that is being incurred in the use of the most costly factor of production, namely, land.

Better use of capital

There is also scope of increasing efficiency by proper distribution of capital between land and its improvements, equipment, livestock and circulating capital. On peasant farms the amount of capital invested in improvements and equipment is usually very small and labour takes the place of a large part of capital. Excepting some small favourably situated tracts, little is done for the permanent improvement of land like embanking, fencing, levelling, drainage, farm-houses, etc. Most of the equipment and tools are locally made and cost little. The chief advantage of these indigenous implements and tools used as they have been for generations, is the ease in making and repairing. A few of these are really efficient for the purpose meant and there is little that can be improved. But there are others which can be replaced by more efficient ones which will give better work and reduce labour cost. The working livestock is usually obtained locally from breed long deteriorated in efficiency. Circulating capital like seed and manure are produced on the farm. Better storage and better use of manure will decidedly give better results. There are times when seed of any kind is obtained from anywhere. In tracts where farming is commercialized, as for instance in sugarcane regions, where considerable quantities of fertilizers like sulphate of ammonia, oilcake and fish manure are used, majority of purchases are made on credit from local commission agents who also act as financiers and selling agents. Considerable saving could be made on individual farms with better organization for credit, purchase and sale, use of better equipment and materials and permanent improvements of land.

Utilization of labour

One of the greatest problems of farm management research is the maximum utilization of human and animal labour as well as of the farm machinery. In fact, labour requirements put a limit to the raising of any crop. It is very essential to plan crops or enterprises which will require attention at different periods so that all available labour may be spread as evenly as possible over the year; to do this intelligently, data on seasonal distribution of labour as well as on the labour requirements of different enterprises become a necessity. On peasant farms the chief criterion in adjusting cropping schemes is not the net profit on individual enterprises, but the duration of employment of the farmer and his family as well as of his work-animals. Indeed a crop may show a net loss, but still may be preferable to another crop showing a net profit simply because of the fact that the crop which shows the higher net profit, or higher return per hour of labour, gives a lower income than the other with a lower return per hour but with a higher total labour requirement which is yet not beyond the normal capacity of the available labour force. The work-animals and farm machinery have to be maintained all through, whether worked or not, and it is very essential to adjust the farm business in such a way as will provide for their maximum use and, thus, reduce their unit costs.

Adjustment of the factors of production

The possibility of organizing a farm successfully depends to a large extent on the availability of land, labour and capital in quantities desired. When all factors are not available with equal ease and one is more plentiful than the others, the problem of organization mainly turns to the economizing of the less plentiful factor or the replacing of it with the more plentiful one. There are possibly two ways of increasing efficiency of any farm organization as a whole. Firstly, by increasing the business to a size which will give optimum results for a fairly long period of time and secondly, by reducing wastes and losses and increasing the yields. In a country where the factors of production are mobile, the first way forms an important line of progress. But when this is not so, attempts along the second way have a great future.

Selection of a profitable enterprise

The aim of a good farm manager will be to obtain the maximum returns over a series of years, making the best possible use of all available labour and capital and without impairing the fertility of land. In deciding on his scheme or organization he will have to consider for what enterprises the conditions of his land are most favourable. But land is not the only consideration. The questions of labour and capital also have to be considered. Land may be most suitable for a particular enterprise but the cost of labour and capital may render the cultivation unprofitable. Lack of opportunity for and cost of marketing, competition of regions growing the same commodity and of substitutes may also make it unremunerative. The habits, customs and racial preferences as well as personal or local likes and dislikes may sometimes affect the selection of enterprise. Or lack of means may, sometimes, limit the choice. Not infrequently there are a number of enterprises for which the land and other conditions are most favourable. It will very rarely pay to extend or develop one or two of the most profitable enterprises excepting such enterprises as dairying in which there is more uniform utilization of labour and capital. But good returns are dependent in no small measure upon a considerable percentage of the most profitable crops and it is very essential to know the relative profitableness of the different crops.

Studies of efficiency and of optimum practices with which the selected enterprises are operated constitute one phase of farm organization research and these will include such things as the substitution of cheaper methods for expensive ones, as for instance, the replacement of labour by machinery, of human labour by animal labour and *vice versa;* the selection of the most suitable type of machinery, tools and equipment in point of quality and quantity of work and their comparative cost, the choice of operations as harrowing *vs.* ploughing and hand-weeding *vs.* hoeing, as well as the elimination of useless and unnecessary operations; the determination of the optimum time for farm operations and of the optimum quantities of labour and material requirements for the various processes in the farm production and the like. In an old country where types of farming are fairly fixed and permanent, there is perhaps limited possibility in the improvement of the choice of enterprises. The crops, which the majority of farmers in any community have been growing for a long time, are generally evolved out of the natural and economic forces as best adapted. Under such condition, possibly the largest improvement in farm organization lies in increasing the efficiency in the conduct of the several enterprises comprising the farm business.

Related enterprises

But the problem can never be wholly divorced from that of the combinations and proportions of the different enterprises. These enterprises are mutually related and their inter-relationships bring forth the questions of adjustments in the size of each and to a certain extent even of the choice of the competing enterprises. Like all other economic activities, farming is dynamic and the questions of farm management can never be settled once for all. But studies in farm organization yield certain principles which hold true for a considerable period. They yield such results as the requirements and distribution of labour and material for various processes. Each farm is a composite unit consisting of several enterprises so arranged as to make the whole business run as profitably as possible, in the opinion of the operator whose success, therefore, depends on the soundness of his judgment. The method of accounting demonstrates the profitable enterprises and provides a basis for working out the best combinations as well as suggests ways of improving the less profitable branches. A large number of farm management studies provide averages or standards which are found of great practical assistance to the individual farmer in testing his own organization in the light of general situation as well as for studying the causes of variations from farm to farm. Because of the wide diversity in the quality of land and of farmers it is not always possible to adopt the standards of practice and of organization so arrived, but the data provided by them are found fundamentally important in working out cropping schemes, particularly in regard to the quantity and time when labour and material are required. They will show what permanent labour is necessary and indicate when extra help is required. If it is not possible to get extra help at the peak periods like sowing and harvesting at reasonable cost, it may become desirable to introduce some labour-saving machinery after working out the comparative costs. Or it may become necessary to adjust crop acreages and introduce supplementary crops which will maintain a more uniform demand for labour. Some crops may be competitive for labour only for certain operations, while they may be complementary for the remaining operations.

Adjustment of enterprises

The amounts and adjustments of enterprises and the apportionment of land, labour and equipment form the next important stage of farm management study. The principal considerations are the labour requirements of the various enterprises and at different seasons in the year, the relative profitableness of different enterprises as well as the provision for rotation and the distribution of income from the farm enterprise. It is, thus, bringing together and organizing the material obtained from enterprise studies, after taking into full consideration the physical and biological possibilities as well as the market and changing economic and social conditions, which are affecting and likely to affect the farm business. Even knowing that they are running their businesses at a loss, the farmers continue to carry on the same sytem. There is considerable time lag before adjustments take place. It all depends on opportunities in other lines of farming or lines other than farming. If there are no other better lines available, the farmer will continue to produce at whatever returns he can make and try to reduce costs with a view to reduce losses. Even if there be an alternative which pays better, it does not always become possible to make an immediate shift. Shifting is extremely difficult in agriculture and often means an outlay of expenditure. But even without sudden shifting it does, many times, become possible to adjust the business in a way which will give maximum results. After the complementary and competitive nature of the crops has been determined, one can find out which of the crops adds the most to the profits of the farm and study the possibility of increasing the size of such profitable enterprises. The next step will be to compare the relative profitableness of the different competing enterprises and see if it is desirable to select only those which add the most to the farm profit as a whole and help to maintain a well-balanced farm unit.

Collection of data

As regards the methods employed in the collection of data, a resume of farm management investigations indicates that there are two principal methods at the disposal of the research worker. The first of these is the *accounting method* and the second is the *survey method*. The accounting method is an intensive method used where detailed records continuous for a period of time are used, while the survey which is an extensive method, is employed when less accurate details are required or when the information is required over a greater area or at recurring periods. The accounting may be *full cost accounting* where detailed costs of labour and material of each of the farm enterprises are separately determined or *enterprise cost accounting* where costs of only one or two particular enterprises are studied, or *financial accounting* where only cash expenses and receipts are analyzed. The selection of either of these three accounting methods will depend on the nature of the problem to be studied and the first thing to be done in clarifying the problems of accounting, before one or more of these three methods are adopted for use, is to prepare a statement of the objectives for which one is striving. The survey may be made of the whole farm business or of a particular section of the business or of a particular practice. The accounting method analyzes in detail the whole or part of the organization of any individual farm with a view to economizing materials and efforts and increasing the returns, while the survey method examines a large number of cases of a similar type in order to isolate certain features which seem to be associated with success or failure. The accounting method aims at getting more accurate and more detailed data from actual records kept on a limited number of farms. The survey data, on the other hand, are in a large part mere estimates hastily made by the farmer usually with the help of the economic recorder but collected from a large number of farms.

Accounting

Accounting may be of personal service type when the economic recorder visits the farm at regular intervals and records the necessary details for the farmer. At the close of the year the records are analyzed and results prepared for the farmer. This is the most primitive type of collecting farm management data by accounting method and is resorted to when making a beginning in farm management investigations and when the farmers are not prepared or do not know how to fill in records. A more advanced method is that of cooperative recording where farmers cooperate in the work, fill in the forms supplied, all the necessary details and send them to the investigating authorities at regular intervals. The records are, then, analyzed for him and he is supplied with a statement of results and remarks on his year's work. Regular visits in such a plan are not found necessary and the farms are visited only a few times—usually two to four times or less according to circumstances of individual farms—in a year. This plan has been found very successful in England and the United States of America. The number of farmers who are prepared to cooperate depends on the kind of records they are required to keep, other conditions being favourable. The more simple the record to be kept, the more likely is to get a greater number and thus, get a better sample. The plan made a remarkable progress sometime ago in Illinois under the leadership of H. C. M. Case and over two thousand farmers were cooperating annually in keeping simple financial and production records. Another plan found rather popular in many of the Continental countries is the formation of book-keeping societies who employ their own farm accountants for keeping usually financial accounts for their members. The accounts are analyzed in some central office and the farmers supplied with results of analysis at the end of the year.

Forms of accounts of any kind, either financial or cost, have got a great educational value, especially when they are kept by the farmers themselves, as in cooperative recording. These may, in certain cases, lead to continuation of recording for its own value to the individual, or to the improvement of records previously kept. This is not absolutely limited to accounting. All recording of forces is of value when the record is given to the farmer, even possibly without analysis or with only simple analysis, because it brings conscious realization and apprehension of facts only dimly apprehended before.

(*To be continued*).

THE 'BAND' DISEASE OF ARECA PALM

By N. V. JOSHI and S. G. JOSHI

THE name 'band' is given to a peculiar diseased condition of the betel-nut or areca palm (*Areca catechu*) in the Konkan tract. The word '*band*' in Marathi language means barren and indicates effect of the disease, viz. non-production of fruits by the affected trees. In the Mysore State this disease is known as the *Hidimundige roga*[1].

The disease

The first sign of the disease is the production of a leaf smaller than the normal. Later, the internodes become shorter and the stems constricted and reduced in size. Lack of vigour in the leaves is perceptible. There is no discolouration of the leaves. On the other hand, the leaves of the 'band' diseased palm become dark green, the healthy ones being light green in colour. The leaves become gradually smaller and smaller and the crown forms a cabbage-like head of shortened leaves. Recently the senior author has observed a new symptom of the disease which may be described somewhat as follows. In the 'band' diseased palm, the long and broad petiole of the leaf (which surrounds the stem and which is known as '*viri*' in Marathi) instead of opening out in due course tends to remain closely packed round the stem, tightly binding down the top portion of the palm and thus, prevents the normal development of the growing point by stopping the successive emergence of leaves at the top. This sometimes results in the shoot forcing its way laterally through the closely fitting leaf bases of earlier leaves (instead of coming out at the top). Also sometimes multiple shoots, all reduced in size, arise in place of a single healthy shoot due obviously to the normal growth being arrested by the presence of the persistent imposed leaf base of the lower leaf.

As far as it is known, the first published account of the 'band' disease occurs in the *Poona Agricultural College Magazine*[2], while the earliest official reference to the disease is in the records of the Janjira State. In 1889-90 the Government of the Janjira State had recognized the gravity of the situation caused by this disease and had felt the necessity of getting it investigated; they had, therefore, requisitioned the services of a Professor of Botany from the Government of Bombay in 1890. The disease may, thus, be said to have been under observation since that time.

The disease has been slowly but steadily growing since then and has extended to adjoining territory in the Ratnagiri and Kolaba Districts. The extent of damage reported by different workers has varied from 5 to 25 per cent in 1916-17, 25 per cent or a little more in 1939 and 50 per cent or more in 1942 according to locality and time of observation.

Cause

The cause of the disease, however, has not yet been definitely ascertained. It is known that no insect or fungus or any other micro-organism is found in connection with this disease and it does not seem to be contagious or communicable, although it is spreading to other localities. From the symptoms it has been surmised that it may probably be due to faulty nutrition. The possibility of its being a virus disease is not altogether excluded but not yet definitely proved. No remedy has been discovered so far, although recommendations have been made for its symptomatic treatment. Empirical remedies suggested by practical growers of betel-nut palms have also been tried for the 'band' affected palms by various owners of gardens but none of these suggestions or remedies have effectively checked this disease.

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[1] Coleman, L. C. and Venkatarao, M. K. (1918). *Dept. Agric. Mysore State Bull.* No. 10, General Series, pp. 19-20.

[2] Gokhale, V. G., Kasargode, Ramrao, S., and Ajrekar, S. L. (1916-17). *Poona Agricultural College Magazine*, Vol. VIII, pp. 49-53.

Investigations

The problem of the ‘band’ disease was brought to our notice early in 1942 by Mr. H. P. Paranjpye who supplied us with samples of soil collected from around the roots of different areca palms suffering from the ‘band’ disease and similar samples of soil collected from around the roots of healthy fruit-bearing palms.

Consideration of the results of the previous investigations suggested two lines of attack which were adopted to trace the cause of the ‘band’ disease, namely (1) the examination of the soils round the healthy trees as well as the ‘band’ diseased trees to observe the relative numbers of bacteria and to compare the bacterial activities in the different samples and (2) a search for the relative amounts of the minor or trace elements, such as boron, copper, manganese and zinc.

Some typical results of this examination are given below:

TABLE I

Number of organisms found by plating on agar medium

Micro-organisms in millions per gram of air-dry soil					
Healthy	‘Band’	Healthy	‘Band’	Healthy	‘Band’
18·7	6·6	26·2	7·3	10·7	4·0

The air-dry samples were moistened by addition of water to the extent of 17 per cent water of the weight of air-dry soil and kept at room temperature for three days and then examined for the number of organisms in the moist soil by plating.

TABLE II

Number of organisms found in moist soil by plating

Micro-organisms in millions per gram of air-dry soil					
Healthy	‘Band’	Healthy	‘Band’	Healthy	‘Band’
39·0	26·5	38·5	26·0	22·5	10·9

The soil samples were also examined for evolution of CO_2 by addition of oil-free oilcake and gave the following results:

TABLE III

Evolution of carbon dioxide

Amount of carbon dioxide evolved in mgm. per 100 gm. air-dry soil in two weeks					
Healthy	‘Band’	Healthy	‘Band’	Healthy	‘Band’
139·7	131·1	132·8	107·4	136·6	122·3

Examination of these samples by the spectrographic method carried out at the Indian Agricultural Research Institute, New Delhi, has shown that while most of the trace elements like boron and manganese showed varying quantities present in both the healthy and the ‘band’ diseased samples, zinc was found to be consistently lower in quantity in the ‘band’ diseased samples than in those from around the healthy trees. The gravimetric chemical analysis for all the trace elements has not yet been carried out to completion and, hence, the results obtained by the spectrographic method need not be considered to be definite. They are, however, useful as a tentative guide for directing our efforts to trace the cause of the disease.

For this purpose in April 1944, six betel-nut gardens were selected in the village Murdi in Dapoli Taluka (Ratnagiri District) for manuring trials with addition of trace elements. Six trees showing definite signs of ‘band’ disease in a fairly advanced stage and six trees just beginning to show the first signs of the disease were marked and numbered in each of the gardens. All the trees in all the gardens were given an equal dose of the usual N.P.K. manures so that the trees may not show differences due to want of any of these elements in the soil. The marked trees were then treated with trace elements according to the following plan.

Instead of repeating all the different treatments in all the gardens, all the twelve trees in each garden were given one treatment only, each garden, thus, representing one kind of treatment for all the twelve trees in it. Thus, there were six separate treatments given for each garden. This procedure prevented mixing up of results and facilitated observation.

The N.P.K. basal dose consisted of ½ lb. ground-nut cake, ½ lb. bone-meal, ½ lb. wood ashes. The differential treatments were as follows:

All the trees in garden A received a dose of

2 *tolas* that is about 25 grams of copper sulphate per tree. In garden B the trees received a dose of 2 *tolas* of manganese sulphate per tree. In garden C, 2 *tolas* of zinc sulphate was applied per tree. In garden D, 2 *tolas* of borax was applied per tree. In garden E all these four materials were applied at the rate of 2 *tolas* of each of them per tree. In garden F the trees were given only the basal dose of N.P.K. manures without any addition of any of the trace elements. This was rather a neglected garden with weeds growing and hence, simple manuring was likely to mask the effect of any trace element if it was to be added.

Results

In the last week of August 1944, each treated tree was examined in company with three local gardeners who gave their individual opinion as to improvement or deterioration by observing the leaves that had emerged after the treatment was given. Increase in length of the new leaf and restoration of normal colour of the leaf were the chief factors considered as an improvement; the shortening of a new leaf and deepening of colour of the leaf were the factors considered as deterioration. The opinions were assessed as follows:

TABLE IV

Results of treatments with trace elements

	Definite 'band'	Beginning of 'band'	Sum total
A Copper sulphate	0,−1,+0,+1,−1,+0	+1,−1,+1,+0,+1,+1	+2
B Manganese sulphate	0,−1,−1,−1,+0,+0	+1,+1,+0,−1,+1,+1	−1
C Zinc sulphate	0,−1,+1,+1,+0,+0	+1,+0,+0,+1,+2,+1	+6
D Borax	2,−1,+1,+0,+0,+½	+1,−1,+0,−1,+1,+0	+2½
E All the salts	1,+0,+0,−1,+1,+0	+0,+1,+0,+1,+2,+0	+5
F No mineral salts	−1,+2,+0,+1,+2,+1	+1,+2,+0,+0,+1,+0	+7

The trees were given marks to facilitate the measurement of all the factors and evaluation of the total effect of the treatment as a single entity and these are noted in the above Table. Their meaning is as follows:

+2 means marked improvement in size and colour of the leaf; +1 means slight improvement and ½ means slight improvement but slight signs of 'band' still persisted; 0=no change observed; —1 means deterioration increasing signs of 'band', −2 means marked deterioration, subsequent examination showed alteration in the marks. The sum totals for the treatments are as follows:

	Sum total of marks
A Copper sulphate	+4
B Manganese sulphate	−4
C Zinc sulphate	+3
D Borax	+1
E All the salts	+6
F No mineral salts	+0

These results show that in the garden F, as was expected, the trees being in need of manure N.P.K. showed improvement at the first time of observation but the effect had disappeared at the time of the second observation. Manganese sulphate showed continuous deterioration showing that the soil probably contains enough manganese and hence further addition tends to deteriorate the condition of the trees making them susceptible to 'band'. This may prove a clue to the cause of the disease.

Copper sulphate did not lead to much deterioration and showed some improvement at the second observation probably lending colour to the suggestion that copper sulphate has same manurial value in small doses.

Borax showed the same improvement at the first observation but there was a deterioration at the second observation; probably it has not much influence on the 'band' disease.

Zinc sulphate which had showed marked

improvement at the first observation has, however, shown lower improvement, that is the effect has not lasted for a long time. Probably this may be due to deficiency of lime in the soil, because it is considered that zinc shows its effect better in the presence of lime.

The addition of all the minerals together has led to improvement in many of the trees, a condition which had lasted at the time of the second observation also showing that the trace elements which have led to this improvement had a better chance in the presence of some other element.

It is hoped that a further study along these lines may lead to some useful clue in tracing the cause of the 'band' disease.

AUSTRALIA CAN HELP TO REDUCE WORLD HUNGER

AUSTRALIA was potentially capable of making a sustained and substantial contribution to the task of feeding two-thirds of the world's population who were going to bed hungry each night, said Mr. Norris E. Dodd, Director-General of the Food and Agriculture Organization of the United Nations.

Australia, in common with the other more advanced members of the United Nations family, had a responsibility to ensure that increased food-production was achieved, said Mr. Dodd.

He considered that Australia was capable of increasing her output of meats (942,100 tons in 1947-48) and wheat (220,000,000 bushels in 1947-48) beyond the requirements of her population, even allowing for future increases.

Even so it would be a long time before the combined resources of the United States and Australia could do much more than take the edge off the mass-hunger in Far Eastern countries.

Mr. Dodd stressed that it was important that Australia, in increasing her output of primary products, should not overburden and weaken her soils.—*Australian Agricultural Newsletter*, No. AGN 241.

SOME HINTS FOR SANN HEMP COOPERATIVE MARKETING SOCIETIES

By PRATAP SINGH

IN a previous article*, the necessity for marketing sann hemp on a cooperative basis was emphasized and an outline of a plan sketched. In order to give an impetus to the scheme, it is felt necessary to acquaint the agencies and the personnel responsible for promotion and direction of the work with some important details as well. Lack of knowledge about these appears to be an obstacle in the way of the initiation and progress of this enterprise. The object of this article is, therefore, to fill in the essential details regarding some practical aspects of marketing sann hemp.

Assembling

The cooperative marketing societies may assemble sann hemp in the following ways:

Firstly, the members may bring their own sann hemp direct to the premises of the marketing societies.

Secondly, the affiliated village societies, wherever they exist, may collect the produce of their constituents and arrange to send it on to the premises of the marketing societies.

In the first case, the produce should be, as far as possible, got cleaned and graded immediately and the total weight of different grades credited to the account of the member who should be given a proper receipt indicating the weight of each grade, and the charge incurred for grading. If a producer himself does the grading a note to that effect may be given in the receipt. If he so desires, up to 75 per cent of the value of his sann hemp calculated in the manner explained in a latter section may be paid to him and an entry made in the receipt. If a seller wants to hold over his produce for sale at some later date and the advance remains in operation for a period of more than a fortnight some interest may be charged while settling accounts.

In the second case an affiliated village society may collect sann hemp of each of its members, and depute one of its office-bearers to take it to the premises of the marketing society. Each member's produce should be weighed and labelled and a receipt given to him. Collection should be made when sufficient quantities are forthcoming to justify the deputing of a person to take it to the marketing society. A *challan* showing the weight and ownership of each lot should be sent along with each day's despatch. On arrival at the premises of the marketing society each lot should be reweighed and its cleaning and grading proceeded with at the earliest. If required, an advance to the extent of 75 per cent of value may be made over to the authorized representative of the village society. It is expected that the village society in its turn will pass on this advance to its constituents concerned.

Outright purchases should be avoided, as far as possible.

After each lot is graded, sann hemp of each grade should be pooled.

Cleaning and grading

At present cleaning and grading are confined to the baler's premises with the result that a huge quantity of refraction (pieces of leaves and stalks, dirt, dust, etc.) has unnecessarily to be transported from the producer's door to the baler's premises. Obviously this practice entails tremendous waste. Even avoidable transport and handling charges are incurred. Precious wagon space is misused in carrying muck. At the top, the producer is deprived of much-needed fuel. Some idea of the magnitude of this wanton waste will be had from the fact that at Shiupur alone roughly as much as 50,000 maunds of pieces of stalks, known as sticks in the common parlance, (apart from other refraction, i.e. pieces of leaves, dust and dirt) over and above

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* 'A Plea and a Plan for Cooperative Marketing of Sann Hemp in India', *Indian Farming*, Vol. VIII, No. 4, April, 1946.

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the prescribed limits allowed for the various grades, which can supplement the fuel resources of the producer are lost to him annually. The irony is that the producer has not only to incur this loss but has also to pay for incurring it. No rational marketing system can countenance such an extravagant and wasteful procedure. If the producers or their societies take up cleaning and grading before marketing their sann hemp they will be greatly helping themselves in eliminating waste. Apart from that the producers will be able to earn wages for their family labour spent in cleaning and grading which at present go to others at the baler's premises. Probably the most important advantage will be the simplifying of the method of working out prices of unbaled sann hemp from those of *pucca* bales as a result of which the producer will be assured of fairer prices.

From the point of view of the balers also, the proposal should be helpful. Their turnover will become quicker as no further processing will be needed except pressing. They will not necessarily have to employ buying agents and even if they do engage a few they will not be cheated as before. The balers at the ports will get an additional facility. They will be relieved greatly of congestion of space (which is so costly there) for cleaning and grading sann hemp at the baling presses. All these economies in assembling and marketing costs coupled with the substantial reduction of risks inherent in the system of buying through buying agents will naturally reduce the balers' working costs. To a great extent the labour problem will also be solved.

In order to enable the producers and their marketing societies to undertake cleaning and grading work, the persons concerned will have to be suitably trained. For this purpose the marketing societies may approach the Agricultural Marketing Adviser to the Government of India, New Delhi and request him to arrange practical training of a few of their employees by the Sann Hemp Inspectorate staff of the Directorate of Marketing and Inspection. This nucleus staff in its turn can impart the required training to the labourers and producers in their respective areas.

Storage

As a general policy the cooperative marketing societies should try to dispose of their sann hemp soon after it is assembled except when particular persons desire to hold it over for sale at some later date. Such persons should be required to make a written declaration of their intention, and to pay rent if their produce is stored beyond a certain stipulated period, say a fortnight. In all probability sann hemp stored during the main marketing season may fetch better price at a later date but it is also likely that during a particular year storage may not prove profitable. Some of the members are likely to overlook the profits and hold the society responsible for the losses. The society should, however, explain the advantages of orderly marketing, if any, on the basis of previous figures and leave the decision to the individual members.

All the same, sann hemp will have to be stored for short periods. In order to economize the storage space it is desirable that it should be stored in the form of *kachcha* bales. Cleaning before *kachcha* baling will further contribute towards economy in space. In the case of Benares Sann Hemp the economy in space is about 20 per cent.

Only thoroughly dry sann hemp should be stored, otherwise the strength of the fibre will be impaired. For the same reason sann hemp should not be stored on damp floors and under leaking roofs. These precautions are very essential and their non-observance may set at naught all efforts in other directions.

During storage sann hemp is liable to be damaged by white ants. Godowns infested with these pests should be avoided and the advice of the local Agricultural Officers should be sought in the matter of preventive measures.

Evaluation of unbaled sann hemp

Normally balers pay prices in the up-country markets on the basis of quotations received from the foreign markets. These quotations are usually per ton of 2,240 lb. From these figures the shippers and balers calculate the price per bale of 400 lb. in rupees after deducting the necessary expenses and taking into account the ruling exchange rates. On the basis of the calculated prices per bale of different trade descriptions and grades the balers fix purchasing limits for different markets for sann hemp with varying refraction contents. The latter factor is specially important in the case of Benares Sann Hemp. Bales of Benares and Chapra Sann Hemp often change hands amongst balers and shippers at Shiupur

(Benares) and prices are quoted locally per *pucca* bale (4 md. 35 seers*). The prices in the up-country markets can conveniently be based on these quotations. In doing so, baling, cleaning, grading, transport and marketing charges have to be accounted for and the refraction contents and grade outturns have also to be taken into consideration. Both these factors, i.e. grade outturn and refraction content, are estimated by visual examination by the buyer or his representative and the seller is entirely at his mercy. While appraising the value of a lot, the buyers usually estimate total refraction and the proportions of the different grades and the total quantity of uncleaned sann hemp required to make a bale. The value is based on almost fully cleaned fibre although in actual practice refraction upto specified limits is allowed in the different grades. This discrepancy alone knocks off as much as Rs. 2 per maund from the producer's price at the prevailing rates (1948). On the other hand an inexperienced buyer may occasionally lose for want of proper judgment. It is, therefore, desirable that a correct method for determining prices of unbaled sann hemp should be devised to make the system straight and rational. The procedure suggested below will be found helpful. In the case of uncleaned sann hemp a representative sample weighing from ten seers to a maund, depending upon the size of the lot, be drawn, cleaned and graded. The weight of each grade should be recorded. The loss of weight will give the excessive refraction in the lot. On the basis of the proportions of the grades, the value of a composite bale may be determined, while on the basis of excessive refraction the weight of uncleaned sann hemp required for one composite bale should be worked out. From the calculated price of the composite bale the baling, cleaning, grading and other incidental charges incurred at the baling centre should be deducted and the net price divided by the number of maunds of uncleaned sann hemp required for one composite bale. This will give price per maund of uncleaned sann hemp at the baling centre. For quick calculations ready reckoner given in Table I may be used. To illustrate, suppose a camel load of uncleaned Benares Sann Hemp has to be evaluated on the basis of prices of pucca bales at Shiupur taken at Rs. 135, Rs. 125 and Rs. 100 per bale of grades I, II and III respectively. The *biris* (small bundles) from different portions of the lot should be taken at random to make up a total of 20 seers. This sample should then be cleaned with the help of the usual spike-board (*kanta*) keeping the refraction content in each grade according to its specifications. Further, suppose that the outturn of the three grades from this sample is 7 seers, 4 seers and 1 seer respectively. Excessive refraction is, therefore, 8 seers, i.e. 16 seers per maund of uncleaned sann hemp. The calculated price of the composite bale may be worked out as follows :

		Price per bale	*Proportion of each grade in the composite bale*
Benares I	...	Rs. 135	7
Benares II	...	Rs. 125	4
Benares III	...	Rs. 100	1

The second and third grades are selling at discounts of Rs. 10 and Rs. 35 per bale respectively as compared with grade I. These differences should be multiplied by the proportions of their respective grades and the total divided by the total of proportions, i.e. 12. This will give the discount for the composite bale. In this particular case the discount works out at Rs. 6-4 per bale (Rs. $10 \times 4 +$ Rs. $35 \times 1 \div$ 12). The price of the composite bale will thus be Rs. 128-12. The cleaning, grading, baling and the other incidental charges (including the cost of rope used as lashing, interest, insurance and the baler's profit) at Shiupur may be put at Rs. 17–12 per bale of Benares Sann Hemp at present (1948). The net price of the composite bale, therefore, comes to Rs. 111. From the ready reckoner it will be seen that when excessive refraction is 16 seers per maund 7 23/24 maunds of uncleaned sann hemp are required for a *pucca* bale†, and that the price per maund of uncleaned sann hemp should be Rs. 12-9-1 when the net price per bale is Rs. 100. To this should be added the prices per maund on the basis of Rs. 10 and Re. 1 per bale, i.e. Rs. 1-4-1 and As. 2 respectively. The price per maund of unbaled and uncleaned sann hemp at Shiupur should thus come to Rs. 13-15-2. On the basis of this figure, price per maund at an up-country market can be worked out by deducting the cost of transporting to Shiupur, the cost of marketing and other incidental charges incurred by the buyer (less any allowance, e.g. *kharcha* and excess weight received by him) at that up-country centre.

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* 400 lb. are actually equal to 4 maunds 34 seers and 7 chhatacks.

† The weight of a bale is taken as 4 maunds 35 seers including the weight of its lashing. The latter weighs about 4 seers and the ready reckoner has been prepared accordingly. In a few cases, however, the weight of the lashing is more or less than this by about ½ seer. This variation in weight does not materially affect the price per maund of sann hemp calculated from ready reckoner, provided the expenditure per bale is so adjusted as to include cost of 4 seers of lashing instead of its actual cost. For instance, if the weight of the lashing is 4½ seers and its price Rs. 3–15 only the cost of 4 seers of lashing, i.e. Rs. 3–8 should be included in the expenditure per bale.

In the case of graded unbaled sann hemp price per maund for each grade may be worked out by deducting the usual balers' working costs indicated above less the cost of cleaning and grading from the price per bale of each grade and taking the refraction content as *nil*.

The problem is comparatively simpler in the case of Benares and Chapra Sann Hemps, because there is a market for these at Shiupur. As regards other trade descriptions, it may be necessary to obtain reliable quotations direct from the foreign buyers and then work out equivalent prices in rupees per bale at the various baling centres. When the balers speculate and prices paid by them in the up-country markets are out of parity with the foreign quotations or prices at the baling centres, the cooperative marketing societies should suspend whatever small purchases they may be making and sell their members' produce locally to other buyers.

Sale

When sufficient quantities of graded sann hemp accumulate the balers should be invited to bid offers. Alternatively offers on the basis of grades may be invited by correspondence. Prices for *kachcha* bales may be worked out as in the case of unbaled sann hemp with the difference that charges for *kachcha* baling have also to be deducted from the balers' usual costs incurred in an up-country market. If suitable offers on the basis of prices of *pucca* bales are not forthcoming the produce may be transported to the baling centres and pressed into *pucca* bales and sold in the market through brokers. Apart from serving as corrective for balers' price quotations, this procedure will enable the society to pocket some balers' profit. The problem of disposal may be comparatively easier in the case of Benares and Chapra Sann Hemps as there is an internal free market for these at Shiupur. In the case of other trade descriptions, however, internal sales may have to be introduced or aid of some shippers may have to be sought. It may become desirable and even necessary to set up an export organization to deal with the baled sann hemp of the various cooperative marketing societies.

If, however, more accurate calculations are required the actual net price of the composite bale may be adjusted in the following manner :

When the weight of the lashing is more than 4 seers, the value of sann hemp equal to the weight of lashing over and above 4 seers should be added to the actual net price of bale and *vice versa*. For instance if the weight of the lashing is 4½ seers and the price of the composite bale Rs. 130, the net price of the composite bale should be increased by the value of ½ seer of the bale, i.e. Rs. $\frac{130}{390}$ or 5 as. 4 p. If the weight of the lashing is 3½ seers Rs. 0-5-4 should be deducted from the net price of the bale.

TABLE I

Ready reckoner for working out prices per maund of unbaled sann

Excessive refraction per maund	Weight of sann hemp required for a *pucca* bale	Net price of a bale at the																											
		Re. 1			Rs. 2			Rs. 3			Rs. 4			Rs. 5			Rs. 6			Rs. 7			Rs. 8			Rs. 9			Rs.
Seers	Md.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.	as.	ps.	Rs.
0	4 31/40	0	3	4	0	6	8	0	10	1	0	13	5	1	0	9	1	4	1	1	7	5	1	10	10	1	14	2	2
1	4 35/39	0	3	3	0	6	6	0	9	10	0	13	1	1	0	4	1	3	7	1	6	10	1	10	2	1	13	5	2
2	5 1/38	0	3	2	0	6	4	0	9	7	0	12	9	0	15	11	1	3	1	1	6	3	1	9	6	1	12	8	1
3	5 6/37	0	3	1	0	6	2	0	9	4	0	12	5	0	15	6	1	2	7	1	5	8	1	8	10	1	11	11	1
4	5 11/36	0	3	0	0	6	0	0	9	1	0	12	1	0	15	1	1	2	1	1	5	1	1	8	2	1	11	2	1
5	5 16/35	0	2	11	0	5	10	0	8	10	0	11	9	0	14	8	1	1	7	1	4	6	1	7	5	1	10	5	1
6	5 21/34	0	2	10	0	5	8	0	8	7	0	11	5	0	14	3	1	1	1	1	3	11	1	6	9	1	9	8	1
7	5 26/33	0	2	9	0	5	6	0	8	4	0	11	1	0	13	10	1	0	7	1	3	4	1	6	1	1	8	11	1
8	5 31/32	0	2	8	0	5	4	0	8	1	0	10	9	0	13	5	1	0	1	1	2	9	1	5	5	1	8	2	1
9	6 5/31	0	2	7	0	5	2	0	7	9	0	10	5	0	13	0	0	15	7	1	2	2	1	4	9	1	7	4	1
10	6 11/30	0	2	6	0	5	0	0	7	6	0	10	1	0	12	7	0	15	1	1	1	7	1	4	1	1	6	7	1
11	6 17/29	0	2	5	0	4	10	0	7	3	0	9	9	9	12	2	0	14	7	1	1	0	1	3	5	1	5	10	1
12	6 23/28	0	2	4	0	4	8	0	7	0	0	9	5	0	11	9	0	14	1	1	0	5	1	2	9	1	5	1	1
13	7 2/27	0	2	3	0	4	6	0	6	9	0	9	1	0	11	4	0	13	7	0	15	10	1	2	1	1	4	4	1
14	7 9/26	0	2	2	0	4	4	0	6	6	0	8	9	0	10	11	0	13	1	0	15	3	1	1	5	1	3	7	1
15	7 16/25	0	2	1	0	4	2	0	6	3	0	8	5	0	10	6	0	12	7	0	14	8	1	0	9	1	2	10	1
16	7 23/24	0	2	0	0	4	0	0	6	0	0	8	1	0	10	1	0	12	1	0	14	1	1	0	1	1	2	1	1
17	8 7/23	0	1	11	0	3	10	0	5	9	0	7	8	0	9	8	0	11	7	0	13	6	0	15	5	1	1	4	1
18	8 15/22	0	1	10	0	3	8	0	5	6	0	7	4	0	9	3	0	11	1	0	12	11	0	14	9	1	0	7	1
19	9 2/21	0	1	9	0	3	6	0	5	3	0	7	0	0	8	10	0	10	7	0	12	4	0	14	1	0	15	10	1
20	9 11/20	0	1	8	0	3	4	0	5	0	0	6	8	0	8	5	0	10	1	0	11	9	0	13	5	0	15	1	1
21	10 1/19	0	1	7	0	3	2	0	4	9	0	6	4	0	7	11	0	9	7	0	11	2	0	12	9	0	14	4	0
22	10 11/18	0	1	6	0	3	0	0	4	6	0	6	0	0	7	6	0	9	1	0	10	7	0	12	1	0	13	7	0
23	10 4/17	0	1	5	0	2	10	0	4	3	0	5	8	0	7	1	0	8	7	0	10	0	0	11	5	0	12	10	0
24	11 15/16	0	1	4	0	2	8	0	4	0	0	5	4	0	6	8	0	8	1	0	9	5	0	10	9	0	12	1	0
25	12 11/15	0	1	3	0	2	6	0	3	9	0	5	0	0	6	3	0	7	6	0	8	10	0	10	1	0	11	4	0

MECHANIZED FARMING

By T. J. JOHN

THERE is a growing realization that to improve the social and economic conditions of agriculturists in India the Central Government, in consultation with the Provincial and State authorities, should prepare pilot schemes for different systems of farming such as cooperative, joint, collective, joint stock farming, etc. suitable to the various conditions obtaining in different parts of India, and, that a comprehensive programme of consolidation is vital to agricultural rehabilitation and the State should not hesitate to exercise some measure of compulsion in this sphere.

Commensurate with the progress of consolidation, mechanized farming is likely to come to the fore and it is opportune to consider whether India should take to mechanized farming.

State of Indian agriculture

India has a population of about 370 millions. For every square mile of occupied land there are about 350 people and about eight out of ten depend for their living on farming. The Indian peasant speaking generally, makes a good farmer but his resources both in extent of land owned and in equipment are about the worst in the world. His methods are primitive, his farming implements are crude and the soil is drained of all fertility. Ordinarily he is steeped in debt and cannot afford better equipment.

Broadly speaking, besides other factors, Indian agriculture is handicapped by unrestricted growth of population with its increasing pressure upon land, multiplication of uneconomic holdings which do not admit of scientific agriculture, indefinite fragmentation of holdings resulting from the law of inheritance and partition, crude and primitive methods of tillage producing the low yield, uncongenial tenures, lack of capital and equipment and inadequate storage, transport and marketing facilities.

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Cooperative farming

These facts have to be taken into consideration in deciding about the agricultural economy of the country. In India the sense of private property is strong and social and economic conditions are not favourable to the new Western ideas of collectivism and communism. In India besides family farming three other types of farming may be considered, viz. cooperative, collective and State farming. With a reorientation of its nature and aims there is no doubt that the cooperative system offers the best line of advance in India. Cooperative enterprise under the village community may be revived and organized as a multi-purpose society which could bring about joint cultivation in irrigated areas in which the holdings are minutely divided and scattered. The society could advance loans to cultivators, decide what crops to be raised, distribute seeds and manures, arrange for grading and sale of produce and organize supplementary occupations like rice hulling, oil crushing, manufacture of agricultural implements, bone crushing, preparation of silage and composting green leaf, sericulture, poultry-rearing, etc. which may give work to ryots in their own village in off-seasons.

Mechanization may lead to soil exhaustion

Now, we may consider how far mechanization is possible in cooperative and other systems of farming suitable to Indian conditions. There is no denying the fact that modern agricultural machinery does away with much of the drudgery of farming and it cuts production cost and increases speed of operation. But it is an error to suppose that it is in itself a means of better farming or of increasing soil fertility. It may intensify soil deterioration by making it possible to farm more acres carelessly, rapidly, and badly. For, intensive agricultural practices are liable to result in quickened soil exhaustion, a point which was recently made by Prof. Albert Einstein.

Mechanization unsuitable for small farms

Moreover, efficient mechanization would mean big investment in machinery and so the area of a farm operated by machines must be big enough to have volume of business to support different kinds of machinery. Again, all crops do not lend themselves to tractor cultivation, for instance, rice, which is the main Indian food crop does not lend itself to tractor cultivation except under certain conditions.

Unemployment due to mechanization

When there are people who think that mechanized farming would help to lower cost there are those that would consider that this would add to rural unemployment. There is a general feeling abroad that we can build up the economic condition of the people by introducing large centralized units of production with modern machinery. This is a conception that requires to be examined carefully before we yield to it. Organizing economic production means bringing together various factors in proper manner. The chief of such factors are natural resources, capital equipment and labour. Under varying conditions varying combinations of these may be called for. In Britain, at the time of the Industrial Revolution, capital was plentiful and so in their methods of production capital equipment looms large. In the U.S.A. labour was scarce while natural resources were almost inexhaustible, hence they took to labour-saving devices. Expansion of such an economic organization will naturally lead to 'saving labour' or in other words, creation of unemployment Hence, in our country, where capital is scarce and labour is plentiful the methods followed in Great Britain and the U.S.A. will naturally be out of place.

Mechanization suitable for land reclamation

But mechanization is essential in big schemes of land reclamation. For instance, in the United Provinces about 45,000 acres of land was recently reclaimed within a period of six months by making use of heavy tractors and bulldozers. With manual labour it would have taken years to complete the work. The Government are proposing to bring under cultivation 1,50,000 acres of land in the Matsya Union, which could be effectively done in a short period only if brought under tractor cultivation. The idea of bringing large areas of jungle lands in some parts of South India under cultivation could be done quickly only if machines are used. Similarly, large areas of land which have been infested by the weed known as *kans* in Central India and *hariali* in Bombay and Madras and the extensive grass lands in the High Ranges of Travancore could be made fit for cultivation only after deep ploughing by heavy tractors. In Travancore reclamation of extensive areas from back waters for paddy cultivation was made possible by power-driven motors and pumps. The 'floating plough' designed to operate in paddy fields, where ploughing is now supposed to be done by bullocks in waist deep water, would make agricultural operations effective and a boon to agriculturists.

Conclusion

A fundamental feature of our agricultural economy is that production is now in the hands of millions of subsistence cultivators, a large proportion of whom depend on uneconomic holdings. In these circumstances, mechanization of agriculture as seen in the U.S.A. or the U.S.S.R., where the average size of farm units is large, is possible only when large-scale irrigation and drainage schemes and schemes of land reclamation already undertaken have made some progress.

Agriculture, the basic industry in the production of food, is in the forefront as never before and the problem of increasing agricultural production is engaging the attention of experts and statesmen in every country. When the social and economic conditions and the land system that have reduced agriculture to its present state are corrected by legislation or executive action, we can look forward to an era of expanding agricultural production in our country.

WHEY-MILK WASTE IN THE PRODUCTION OF *CHANA*

NUTRITIONAL investigations in the Biochemical Laboratory, Dacca, have shown that the Indian dietaries, specially the rice diet, are extremely deficient in calcium and that this deficiency can be made up by supplementing at least 10 oz. milk daily[1]. But the total production of dairy product in India does not permit the consumption of the above quantity of milk with our daily diet. The *per capita* production and consumption of milk in our country are near about 7 oz. and this level is not only below that of some other countries where the average *per capita* consumption ranges from 25 to 40 oz. but is also below the minimum limit of 10 oz. required to meet the calcium deficiency of our diets. Moreover, the poor section of the vast population of India cannot afford to pay the high price of milk and milk products and thus, during the whole period of their lives they are completely deprived of this essential foodstuff. In view of the poverty of the major population of India the provision of calcium in their dietaries from some cheap but rich source other than milk assumes a very important nutritional problem and attempts have been made in different laboratories to seek out some cheap sources of available calcium.

Aykroyd and Krishnan[2] have suggested the use of calcium lactate as food supplement to meet the calcium deficiency of the 'Madrasi' diet. In course of our searches for other sources it was found that the habit of chewing betel-leaves with lime, betel-nuts and *catechu* after meals—a very popular habit in India—provides a fair amount of available calcium[3]. A good amount of calcium is ingested and utilized in this process and it costs only a few pies for a large family. Another cheap source is the small fish as *kakchi* (*Conica sobona*), *mala* (*Amblypharyngodon mola*), etc. which are generally taken *in toto* after thorough mastication in the mouth. The bones of small fish, in which is concentrated about 98 per cent of the total body calcium, supply a large amount of utilizable calcium to our diets[4]. The consumption of 2 to 3 oz. of small fish which is comparatively cheaper than the big ones can meet the calcium deficiency of our diet at a little cost. Recently another cheap source of available calcium has been found out after extensive studies on this subject in this laboratory.

In almost all parts of India large quantity of sweets as *rosogolla*, *sandesh*, *lalmohan*, etc. are daily prepared from the dairy products, *chana* (coagulated milk) and *maoa* (evaporated whole milk powder) and are consumed by the rich section of the population. In the preparation of *chana* the whole amount of whey containing the essential nutrients such as lactose, calcium, protein, etc. is thrown away every day as waste. The calcium content of the different samples of whey collected from the market was found to range between 62 to 130 mg. per 100 c.c. In a province like Bengal* about 1,200 tons, i.e. 34,000 md. of whey is daily thrown away as such and the net available calcium wasted away along with the above quantity of whey is approximately 9 tons. Thus, in the preparation of luxurious and palatable dishes for the rich, tons of food essentials are thrown away as waste in some manner or other.

By experiments both on rats and human-beings it has been found that whey given as supplement with our daily rice diet can supply adequate amount of calcium which is utilized within the body to the extent of 80 to 95 per cent[5]. The daily maintenance requirement of calcium of a normal Indian adult has been assessed to be 432 mg.[1] but the poor rice diet containing rice, *dal*, vegetables and small amount of fish (big variety) supply only 200 to 300 mg. of calcium and this calcium deficit of rice diet may be made up if 7 to 8 oz. of whey is taken daily along with the above diet. By supplementing in this way, 1,200 tons of whey thrown away as waste in Bengal can make up the calcium deficiency of 5·5 million people of this province. It is quite clear from the above calculation that food waste of the richer section of the population can save the lives of millions of poor people of India.

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[1] Basu, K. P., Basak, M. N. and De, H. N. (1941). *Indian J. Med. Res.*, **29**, 105

[2] Aykroyd, W. R., and Krishnan, B. G. (1937). *Indian J. Med. Res.*, **25**, 367

[3] Basu, K. P., Basak, M. N. and De, H. N. (1942). *Indian J. Med. Res.*, **30**, 309

[4] Basu, K. P., De, H. N. and Basak, M. N. (1942). *Indian J. Med. Res.*, **30**, 417

*Refers to undivided Bengal.

In these days of food shortage the whey thrown away as waste should be best utilized as a food supplement for supply of nutritionally available calcium to the poor rice eaters' diet. The best way of consuming this whey is to boil the various food ingredients as *dal*, fish and vegetables along with this product. This process of boiling kills the injurious micro-organisms which might grow therein while stored in sweet shops. (H.N.D.)

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[5] De, H. N. and Som, A. B. (1948). *Indian J. Vet. Sci.*

DEVELOPMENT OF VEGETABLE FIBRES

THE Indian Council of Agricultural Research is considering a scheme for the development of fibres other than jute and cotton and it is proposed to appoint shortly a Vegetable Fibre Expert for investigations in this line.

In India there are a number of vegetable fibres which can be put to practical use if properly treated. These are: Hard fibres like sesul hemp, aloe fibre and bowstring hemp; soft fibres like sann hemp, Deccan hemp and soft or true hemp; and textile fibres like flax and linseed fibre and Rhea and nettle fibre. Sometime back, the Government of India had appointed a Fibre Development Officer to collect and collate all available information on the subject. The report of this officer was considered last year by a Fibres Committee set up by the Indian Council of Agricultural Research which recommended the appointment of a Vegetable Fibre Expert to advise on the future lines of research and on the establishment of research stations.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. May I know if Buckwheat is being cultivated or has been tried by the Agricultural Department in any part of India and if so, with what results? Will you please refer me to any literature available on this crop under Indian conditions? (B.S.N.)

A. Buckwheat is cultivated to some extent in the Himalayan ranges for gram and also as a leafy vegetable. No published reports appear to be available regarding its trial in the plains. The reason for this position may be that it is not considered an economic crop when compared to other food crops. Small-scale trials with the cultivation of Buckwheat have been carried out in the Division of Botany, Indian Agricultural Research Institute, New Delhi with a few Darjeeling and Chinese varieties. The crop grows and matures well as a winter crop but severe frosts have been observed to damage the crop. The Chinese varieties are early maturing. In case any more information in this connection is required, a reference may be made to the Director, I.A.R.I., New Delhi direct. (I.C.A.R.)

ADVISORY SERVICE FOR WORLD'S FARMERS

WORLD-wide interest is being shown in Britain's National Agricultural Advisory Service. The object of its work is to provide practical advice and demonstrations on methods of increasing food production.

During the past six months there have been visitors from all parts of the world seeking advice. They have come from North America, Latin America, Europe, the Far East, and most of the Commonwealth countries.

Britain is divided, for the purposes of the Service, into districts, each consisting of about 1,000 farms. The head of each district is the local Agricultural Officer. He keeps in daily touch with the farmers in his area, meeting them on their farms, at weekly markets, at evening gatherings, and at agricultural demonstrations.

The Agricultural Advisory Service is also making an important contribution in helping to train young men in the highest principles of good husbandry.—(*L.P.S.*)

What's doing in All-India

BIHAR

J. S. PATEL

THE weather in the *kharif* (1948) season has been uncertain. In many places the month of June was abnormally hot and dry. In some places there has been too little rain for paddy transplanting or for the growth of the paddy, whereas in other places there have been too much rain and flood. Flood seriously damaged the maize and paddy crops in parts of Patna, Shahabad, Saran, Gaya, Monghyr and Bhagalpur districts. The outlook for the *kharif* crops is, therefore, very gloomy. In some parts high land maize suffered badly owing to hot dry winds.

Manurial Tables

A scheme on the soil survey and the preparation of Manurial Tables for the province started functioning from 6 April, 1948. The object of this scheme is to gather accurate knowledge for advising cultivators of different parts of Bihar as regards the most profitable use of manures and to assess accurately the productivity of different classes of land in the province and the extent to which the productivity could be increased by proper manuring. Simple manurial experiments on maize and paddy have been laid down in about three hundred cultivators' plots. More complex experiments have been carried out on eight Government experimental plots. It is proposed to conduct during the next *rabi* season nine hundred experiments on wheat, barley and gram in the cultivators' plots and to test the effect of nitrogen, phosphate and boron. Thirteen complex experiments will also be carried out on Government farms.

Sugarcane research

Though the sugarcane crop started under adverse weather conditions, it has not suffered much. The varieties C.O. 453, B.O. 10 and B.O. 11 are gaining ground. The former variety is meant for the highest tonnage and medium sugar while the latter two combine both high tonnage and juice quality. According to yield potential survey, the average yield for the province in 1947-48 was 432 maunds as against 347 maunds of last year. Sugar recovery was also 0·5 units better than last year. Ratoons formed only 6·08 per cent of the total fields and yielded about 80 maunds per acre less than the plant crops. The low level fields comprising of clayey soils have given the best yields. The level fields were found to be medium yielders. In small holdings the yield of cane was found to be less than in bigger holdings. The yield was 324 maunds per acre up to the size of one acre and rose up to 421 maunds at a stage when the size was above six acres.

Termites caused severe loss to germination in most of the districts of Tirhut Division. The attack of mites and white fly was very heavy on C.O. 453 and B.O. 11 at Motihari and Majhaulia. Smut infection was pronounced in the ratoons of C.O. 513, C.O. 313 and C.O. 453. The root parasite was reported from Lauriya (Champaran), Hathua and Pachrukhi in Saran district. Experiments with 'methoxone' were conducted in the Hathua area with the power-dusting and spraying equipment spared by the Imperial Chemical Industries Ltd., Calcutta. Red stripe disease was noticed in a few fields of Majhaulia and Harinagar areas.

Experiments on the clarification and preservation of *gur* were conducted at the Sugarcane Research Station, Pusa. *Gur* obtained by using castor seed and groundnut seed extract is reported to be superior to the product obtained by using *deola* and *falsa* bark extract. For storage of *gur* in boxes waxed paper or paper oiled with linseed oil and chalk was found satisfactory. The mouths of kerosine tins or earthen vessels containing *gur* can be closed

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with cloth painted with linseed oil and lime, or coal tar or white zinc paint.

Fruit production

The staff employed under the Fruit Production Scheme visited 992 places. In each of these places, an acre of old orchard has been improved by cultivation, manuring and pruning. Fifty-one acres have been brought under fruit trees and 2,200 fruit seedlings and grafts have been distributed. The demand for fruit grafts and vegetable seeds could not be met fully and requests for supplying trained *malis* could not be complied with.

It has been found out that nitrogenous manure given in the form of ammonium sulphate supplemented by organic manure is the most effective for mango crop and the best time for its application in any form is the month of June immediately after the harvest of mango.

minor irrigation

During March to May, 1948, in Bhagalpur Range 68 minor irrigation schemes other than wells, benefiting an area of 5,112 acres, were completed and 21 wells were sunk benefiting an area of 247 acres. In Patna Range 36 minor irrigation schemes other than wells and 111 wells were completed during the same period. From July to August in Bhagalpur Range 47 minor irrigation schemes other than wells were completed benefiting an area of 3,178 acres and 214 wells were completed. In Bhagalpur Range 330 maunds of jute seed and 450 lb. of vegetable seeds were distributed and 50,000 maunds of compost were applied.

Demonstrations on paddy, Napier fodder, application of sulphate of ammonia and preparation of compost were carried out throughout the province.

Cooperative societies

Cooperative societies are assisting their members in sinking new wells, constructing minor irrigation works, reclaiming waste lands, purchasing cattle, supplying manures and distributing important paddy and vegetable seeds and in maintaining stud bulls and Leghorn cocks.

Marketing

Marketing enquiries were conducted on *mahua*, *til*, *niger*, poppy, linseed, *kusum*, rice, animal fats and by-products, meat, butter, chillies, mangoes, etc. during the quarter under report. Three thousand and sixteen maunds of *ghee*, 835 maunds of *gur* and 2,300 maunds of tobacco were graded. The daily ruling prices of all important agricultural commodities in the Patna market were, as usual, broadcast from the All-India Radio Station, Patna.

The scheme for the administration of Bihar Standard of Weights Act, 1947 was sanctioned.

INOCULATION OF RANIKHET VACCINE IN VILLAGES

S. K. BHADURY

VACCINATION of poultry in villages is a difficult task, and perhaps more so with Ranikhet vaccine. The work was made easy so long as it was restricted to organized farms, for all facilities including storage of vaccine under a state of constant refrigeration, assembling of birds, etc. were available. In the villages it is a different proposition altogether.

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Difficulties of inoculation in villages

Our average villager is so conservative that it takes a long time to convince him about the usefulness of a new enterprise.

Another obstacle that becomes embarrassing is in assembling the birds. Unlike cattle, the village poultry could neither be assembled in the field nor collected from the field. They are to be inoculated just where they are. This means a door-to-door campaign to be launched at dawn. Regard having had to the time factor, *vis-a-vis* viability of the R. D. Vaccine after issue from the laboratory, a speedier use of the vaccine has always got to be kept up in view in order to achieve good result. Therefore, more the delay in one village by way of door-to-door campaign, greater the risk of the product deteriorating towards the end, due to too much exposure and too much handling. Thus, the product once issued from the laboratory is fraught with the danger of being sterile at the later stage. The one and the only one way of maintaining the potency of the virus known at present is by keeping it sufficiently cool, preferably at ice-cool temperature, but unfortunately ice is a commodity seldom available in the village.

Some practical measures

In order to overcome some of the abovementioned difficulties, the following measures were adopted on an experimental basis at a typical village about 15 miles away from Calcutta.

(1) The people were persuaded to agree to inoculation of their birds against Ranikhet disease. To suit the convenience of the owners arrangements were made for vaccination at their premises.

(2) Two vaccinators were deputed the previous evening to the 'experimental' village. They were equipped with kit boxes each containing a measure cylinder, a one litre flask, a gallipot, sterilized 1 c.c. syringe, hypodermic needles, etc. Each vaccinator was also provided with a one pound-capacity thermos flask. Each thermos flask contained an ampoule of R. D. Vaccine (0·25 c.c.) stored in ice. Each flask in kit box contained 250 c.c. of N.S.S. measured and issued by the laboratory. The men were also provided with a third thermos flask containing extra ice.

(3) The village *chowkidars* were instructed to arrange for accommodation of the vaccinators in the village for the night and to inform every householder to keep birds in their respective houses ready for vaccination next morning.

(4) Before operation the vaccine was diluted on the spot in the measured quantity of N.S.S. The diluent was cooled by placing the flask in a bucket containing fresh and cool tube-well water (which is usually cooler during summer) to which was added iced water made available from the thermos flasks. The diluted vaccine was then shared by the operators in two gallipots and the work began from house to house, the operators travelling in opposite direction.

(5) The work was started at dawn at a brisk pace and within about a little over an hour, nearly 300 birds were vaccinated. The remaining 200 doses were discarded.

Remote villages not served

It was found that the above procedure was workable and manageable in villages situated near a central laboratory. But in the case of villages that are remote or not easily accessible, a six-day journey from the laboratory to the place of operation was in some cases unavoidable. Such transit difficulties are a common feature in West Bengal. Notwithstanding every effort to reach the remotest village with the greatest possible care in maintaining the viability of the vaccine, some parts of the province would still have to remain uncatered on account of the very fragile nature of the vaccine.

Unfortunately, however, we have at present in our province only two vaccine depots equipped with refrigeration plants. With the inauguration of the scheme for the control of Ranikhet disease in the field, it is expected that the Directorate would soon have at least one more vaccine depot. In spite of all departmental expansion and organization, which is undoubtedly of great benefit and importance, the success of the measure would depend substantially upon the field vaccinators. A product which will do away largely with the complexities of delicate handling, storage, fluctuations of atmospheric temperature, humidity, etc. would be most welcome. A search must, therefore, be made to find out a vaccine that will be more stable in its property and withstand the fluctuations of temperature more effectively.

EAST PUNJAB

JASWANT SINGH

ON account of heavy monsoon rains considerable damage was done to crops in the districts of Rohtak, Gurgaon, Karnal, Ambala, Simla, Jullundur, Amritsar and Gurdaspur. The condition of standing crops like sugarcane, cotton, millets, pulses and fodder is of average type except in the areas which has been affected by the recent rains, and the yield is estimated below average. Damage to crops by *Kutra* insect has also been reported in the Hissar District. The fodder position is satisfactory in the province except in certain areas of Amritsar District where, on account of heavy rains this year, fodder shortage is being felt.

Tractor cultivation

By borrowing ten tractors from the Central Government the Department of Agriculture was able to plough about 4,000 acres of land vacated by Muslims. In order to modernize agriculture and bring under the plough large areas of waste land, the Central Government had undertaken to work 175 tractors in units of 25 in concentrated blocks at various places on no profit no loss basis. Out of this 100 tractors have been received. A tractor-testing station at Karnal has been started which will test implements and machinery used with the tractor, and remodel them to suit Indian conditions. The cost of tractor cultivation will also be worked out. One Deputy Director of Agriculture (Tractors) has taken over charge of this scheme, and he is assisted by other subordinate officers.

Ammonium sulphate

A subsidy of Rs. 1,47,125 has been given by the Central Ministry of Agriculture to the East Punjab Government to meet half the cost of the scheme for distribution of 4,000 tons of ammonium sulphate during 1948-49 in connection with the 'grow more food' campaign of the province.

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Fodder crops

The East Punjab is deficient in respect of *jowar* (*Sorghum*) seed and large quantities are imported from other provinces. The Department of Agriculture has recently produced a new variety of *jowar* No. 263 which gives high fodder as well as seed yields. It is a fairly tall-growing variety, has medium thick stalks and broad leaves. The ears are dense and have cream-coloured plump grains.

Hand tools

From the quota of iron allotted by the Central Government to the East Punjab, a large number of hand tools and improved implements have been manufactured and supplied to the farmers. Iron pieces for hand tools are sold to the farmers at control rates through Departmental seed agencies, and these pieces are manufactured into tools by the village blacksmiths for the farmers. Iron for implements, however, is supplied to the fabricators, who manufacture implements of approved design and quality for sale at prices fixed by the Department against permits issued by the local agricultural officers.

Fruit preservation

One of the activities of the fruit section of the Department of Agriculture has been to impart training in fruit and vegetable preservation on home scale by holding demonstration classes at various centres. As the Staff meant for this work heretofore exclusively consisted of men, some women's institutions hesitated to take advantage of this service. With the object of overcoming this difficulty and to meet the ever-growing demand from such institutions, the Government have provided a special Lady Demonstrator who conducts short demonstration classes and courses in the Girls' Schools, Colleges, and other institutions, and even at such places in the East Punjab where a number of educated ladies are keen to receive this training. The public will surely take advantage of this free service offered by the Department.

FOODGRAINS PRODUCTION IN 1947-48

THE latest returns from provinces and States regarding acreage and production of foodgrains in 1947-48 show an increase of nearly 6 lakh tons in production of the principal foodgrains during the year as compared to 1946-47. The increase in production occurred in the Central Provinces and Berar, Bombay and the United Provinces and amounted to about 19 lakh tons. This was partly set off by a loss of nearly 12 lakh tons in Madras because of a failure of the north-east monsoon. There was also a decline in production in Assam, West Bengal, Bihar, Orissa and East Punjab totalling about 6 lakh tons, but reporting States of the Indian Union accounted for a net increase of about 4 lakh tons.

Acreage

The figures below show the acreage in 1947-48 under the principal foodgrains as compared to that in 1946-47 :

Foodgrains		Acreage 1946–47	Acreage 1947–48	Increase (+) or Decrease (–)
		Figures in thousands		
Rice	...	60,987	59,656	(–) 1,331
Wheat	...	24,348	20,209	(–) 4,139
Jowar	...	37,844	35,665	(–) 2,179
Bajra	...	21,442	19,626	(–) 1,816
Maize	...	7,888	7,755	(–) 133
Ragi	...	5,174	5,108	(–) 66
Barley	...	7,082	7,127	(+) 45
Gram	...	16,971	18,498	(+) 1,527

Except for an increase in acreage under barley and gram there has been a decrease in the case of all the other foodgrains. The increase in barley has occurred in Rajputana States and Gwalior and in gram, substantial increase in acreage was effected in the East Punjab, the Central Provinces and Berar, the United Provinces, Delhi, Gwalior, East Punjab States and Rajputana States.

Production figures

The figures of production of the principal foodgrains during 1947-48 as compared to that of 1947-48 are :

Foodgrains		Production 1946–47	Production 1947–48	Increase (+ or Decrease (–)
		Figures in thousand tons		
Rice	...	19,856	18,769	(–) 1,096
Wheat		4,744	5,348	(+) 604
Jowar	...	5,277	5,730	(+) 453
Bajra	...	2,667	2,525	(–) 142
Maize	...	2,035	2,111	(+) 76
Ragi	...	1,476	1,391	(–) 85
Barley	...	2,414	2,488	(+) 74
Gram	...	3,599	4,310	(+) 711

While there has been a reduction in the case of rice, *bajra* and *ragi*, wheat, *jowar*, maize, barley and gram record increased yields.

Rice showed an all round decline in production except in the United Provinces and Central Provinces where there was a rise. Increase in production in wheat occurred in Bombay, Bihar, Central Provinces and the United Provinces. The United Provinces and Central Provinces and Bombay produced more *jowar*. Production of *bajra*, maize and *ragi* increased in the United Provinces and Bihar while barley and gram showed a substantial increase in the East Punjab and the United Provinces. These figures do not include those of increased production in the Indian States, for which separate figures are not available.

Position in provinces

The position in each of the provinces regarding acreage and production is as follows :

Assam : The production figures are available only in respect of rice. The decline in outturn in 1947-48 as compared with 1946-47 was 1,01,000 tons and is attributed partly to a smaller acreage because of unfavourable weather conditions at the beginning of the season, and partly to the damage caused to the crop by floods, especially in the low-lying areas of most of the districts. Insect pests in some districts and hailstorms in others also affected the crops.

Bihar : The total decline in the outturn of eight major foodgrains during 1947-48 was 79,000 tons. The decline was accounted for mainly by rice and partially by barley and gram. In the case of other foodgrains there was actually an increase in production. The decline in the outturn of rice was due partly to a reduction in acreage as a result of scarcity of rains at the time of sowing and partly because of unfavourable weather conditions.

Bombay : In Bombay, while the acreage under all the eight principal foodgrains showed a reduction, the total outturn showed an increase of 227,000 tons or 8·2 per cent. The increase was mainly accounted for by *jowar, bajra,* maize and wheat. The last crop had suffered serious damage due to rust during 1946-47. The outturn of rice, *ragi,* barley and gram showed a decline.

Central Provinces and Berar : Central Provinces and Berar produced 895,000 tons of foodgrains more in 1947-48 than in 1946-47. This was mainly due to appreciable increase in the outturn of rice, *jowar* and wheat.

East Punjab : The total decline in the production of wheat, rice, *jowar, bajra* and maize during 1947-48 was 328,000 tons, due partly to a smaller acreage on account of insufficient rains at sowing time and partly to damage caused to crops by communal disturbances, and by floods in the case of *jowar* and maize crops. The production of barley and gram, however, showed an increase of 212,000 tons.

Madras : The total decline in the acreage and outturn of major foodgrains during 1947-48 was 1,326,000 acres and 1,155,000 tons respectively. The decrease in area was due to insufficient rains at the time of sowing. The decline in production was due mainly to the failure of the north-east monsoon rains in some districts and excessive rains in the Circars, during the month of December, 1947. Rice, *jowar* and *ragi* crops were also reported to have been affected to some extent by insect pests in certain districts of the province.

Orissa : In Orissa the production showed a decline of about 86,000 tons which was almost entirely accounted for by fall in rice production. The area under rice during 1947-48 showed a slight increase (i.e. 63,000 acres) but the outturn showed a decline due to unfavourable weather conditions.

United Provinces : Production of all major foodgrains showed a general increase, the total increase amounting to 817,000 tons.

West Bengal : The total decline in the outturn of eight major foodgrains in 1947-48 was 219,000 tons, which was mainly accounted for by fall in rice production. The weather conditions were adverse in the early stages of the crop, tausing diminution in acreage and lower yield. Some damage was also reported to have been caused by excessive rains in some parts of the 24-Parganas and by floods in Murshidabad and Birbhum. The outturn of *jowar* and *ragi* remained practically the same as during 1946-47.

Increase in States

The total increase in production in the reporting Indian States was 419,000 tons, which occurred mainly in Rajputana States, Central India States, Eastern Agency States, East Punjab States and Gwalior. Hyderabad and Bombay States recorded a decline in production of major foodgrains amounting to 79,000 tons and 23,000 tons respectively. (*P.I.B.*)

Across the Borders

SOYBEANS YESTERDAY AND TODAY

By W. J. MORSE

THE early history of the soybean (*Glycine max* (L) Merrill), an annual summer leguminous plant, native of south-eastern Asia, like many other food plants, is lost in obscurity. Ancient Chinese literature, however, reveals that the soybean was extensively cultivated and highly valued as a food centuries before written records were kept. The first written record of the plant is contained in a *materia medica* describing the plants of China, written by Emperor Sheng Nung in 2838 B.C. The soybean is repeatedly mentioned in ancient and modern records with innumerable references on methods of culture, varieties for different purposes, and numerous uses for food and medicinal purposes. It was considered the most important cultivated legume and was one of the five sacred grains—rice, wheat, soybeans, barley, and millet—essential to the existence of Chinese civilization. Available historical records indicate that it is one of the oldest crops grown by man.

The soybean, therefore, has been grown to a greater extent in Asiatic countries than in any other part of the world. China led all other nations in acreage and production, and Manchuria, commonly called the 'Land of the Soybean', was a close second during pre-war years. The United States, however, following a great expansion of acreage and production in 1942, has advanced to world leadership.

Interest in the soybean and its products—oil and oil-meal—spread rapidly to the Western World after World War I. This interest gradually increased, and during World War II the soybean became a highly essential and vital crop in the international war-emergency programme. At the present time agricultural experiment stations of all nations are engaged in the development of varieties adapted to the various soil and climatic conditions of their respective countries and in studies on fertilization, culture, and harvest for economical production. Successful results have been obtained in several countries, but only in a few has the crop become an important factor in their national agriculture.

The principal regions of soybean production in the Orient are China, Manchuria, Korea, and Japan. In China the soybean is one of the leading and most ancient of crops, ranking fifth in extent of culture and occupying about 9 per cent of the total cultivated area. Although grown everywhere in China, about 60 per cent of the soybean acreage and production is confined largely to three Northern Provinces, Shantung, Kiangsu, and Honan. China consumes practically all its production, estimates indicating 55 per cent for food, 27 per cent for oil extraction and other purposes, 10 per cent for stock feed, and 8 per cent for planting.

The soybean occupies about 25 per cent of the total cultivated area of Manchuria and is a dominating factor in the life of that country. As a cash crop, it provides fully half the total volume of freight handled by Manchurian railroads. Estimates have indicated that from one-third to two-thirds of the production of soybeans was exported; 15 to 20 per cent utilized for food, seed, and planting; and the remainder processed for oil and oil-meal.

Korea occupies third place among the soybean-producing countries of Asia. Acreage and production are confined largely to the central and northern areas, because Southern Korea, growing chiefly cotton and rice, seems less well-adapted to soybean-seed production. The entire seed production is used for food, stock-feed, export, and planting, none being used for oil extraction.

Japan, although a large producer of soybeans, has consumed all its own production and imported large quantities of seed from Manchuria and Korea. Since World War I, production of soybeans in Japan has decreased to some extent, more emphasis being placed on the greater production of rice. The proportion of soybeans used by Japan for various purposes was: *Miso* (soybean-rice fermented paste), 22 per cent; Soy sauce, 22 per cent; oil and oil cake, 21·5 per cent; bean curd, 15·5 per cent; confections, 7·2 per cent; forage, 6·2 per cent; green manure 2·5 per cent; seed, 1·8 per cent; green vegetable beans, 0·8 per cent; and miscellaneous 0·5 per cent.

In the Soviet Far East the soybean is said to be one of the chief industrial crops and in some districts to constitute 20 per cent of the cultivated area. Acreage and production have increased markedly since 1926, especially in the Khabarovsk territory.

South of China the soybeans is cultivated more or less in the Netherlands Indies, India, Siam, Cochin-China, the Philippines, and Australia. With the development of improved varieties, acreage and production have increased rapidly, and from 1932 until 1936 beans were exported from the Netherlands. In India the soybean has been considered more for its forage and food values than for growing as an oilseed. In Australia successful results have been obtained in seed production, especially in the States of Queensland, New South Wales, and Victoria.

Attempts to grow soybeans in European countries have extended over many years, but it is only within recent years that there has been any appreciable production. Acreage at the present time is confined largely to European U.S.S.R., Bulgaria, Yugoslavia, Roumania, Austria and Czechoslovakia. In the development of adapted varieties, some progress has been made in Sweden, Poland, the Netherlands, and Hungary. Scientists of the U.S.S.R. have carried on extensive tests in the development of adapted varieties and in utilization of the crop. The principal areas of production are the Ukraine, Moldavia, and certain regions of the Caucasus.

Although experiments with soybeans have extended over a period of years in nearly all regions of Africa, as yet it is an unfamiliar crop to most African farmers. Successful results have been obtained in the upland, midland, and coastal districts of Natal, in Gambia, Nigeria, Egypt, the Gold Coast Colony, and in the corn and cotton-growing districts of Belgian Congo.

The soybean has been experimented with for many years in nearly all countries of the Americas. Little progress has been made, however, in commercial production, except in the United States and Canada. In the United States there are three rather distinct regions of soybean production—North Central, Mississippi Delta (Mississippi, Arkansas, Louisiana, and south-eastern Missouri), and Middle Atlantic Coast. Seed production is largely concentrated in the North Central region, where nine States—Illinois, Iowa, Indiana, Ohio, Missouri, Minnesota, Kansas, Michigan, and Wisconsin—produced 92 per cent of the record crop of 201,275,000 bushels in 1946. Of the Middle Atlantic States, North Carolina, Virginia, Maryland, and Delaware are the chief seed-producers.

The phenomenal increase in acreage and production in the United States may be attributed to the following factors: Improved, adapted varieties for industrial uses; mechanization of the handling of the crop through improved machinery for seeding, cultivating, and harvesting; one of the most profitable cash grain crops; less damage from diseases and insect pests than other common crops; dependable producer of forage and grain under adverse weather conditions; a legume fitting favourably into Corn Belt rotations and crop-control programmes; and available industrial markets.

In Oriental countries the soybean is grown primarily for the seed, which is used largely in the preparation of numerous fresh, fermented, and dried food products. For centuries the protein part of the diet of millions of Oriental people has been supplied or supplemented, to a great extent, from soybean products. Fermented, the soybean yields all the different sauces which furnish the basic flavouring of their food; pressed, it gives oil for cooking; sprouted, it furnishes a fresh vegetable rich in vitamins; picked when green, it makes an excellent green vegetable; ground dry, it makes flour; soaked, ground and mixed with water, it provides bean milk, and the curdled milk furnishes bean curd, the boneless meat of the Orient used in the form of various cheeses and as a meat substitute. The roasted beans are often salted; they are also used in cakes and candies; fermented bean pastes are used in soups and in preserving vegetables; and boiled beans are mixed with millet, rice, or *kaoliang*. The soybean has meant bread, meat, milk, cheese, and vegetables to these peoples and furnished what is said to be a well-balanced diet at a relatively low cost.

Although the people of Asiatic countries have long appreciated the many uses of the soybean for food, it is only within comparatively recent years that the people of the Western World have awakened to the potential utilization of this unique legume as food. The importance of legumes as an economical source of protein in the human diet has become quite generally recognized throughout the world. The soybean, in view of its richness in digestible nutrients—as indicated partly by its unusually large percentages of protein and fat—deserves high rank as a food. European scientists for many years have realized the high nutritional value of soybean protein and fat, and Europe has been one of the principal importers of soybeans from Manchuria and the United States. During World War II Germany published an army field cookbook containing nearly 300 recipes in which full fat soy flour was used to supplement meat, milk, eggs, and cheese in the soldiers' diet. Since the close of the war millions of pounds of soy flour, as well as considerable quantities of beans, have been sent to European and Oriental countries.

The soybean has been considered primarily as a forage crop in the United States, but during the past few years remarkable progress has been made in developing food and industrial uses of the soybean. At present 140 oil mills are crushing soybeans; about 200 concerns are manufacturing or processing soybean food products; and more than 100 manufacturers are turning out various industrial products from this bean.

Soybean foods receiving the most attention at the present time are flour, flakes, grits, and oil. Improvement in processing during the past few years has resulted in the manufacture of soy flours that are much superior in flavour and keeping qualities to those first placed on the American market. Three general types of soy flour are now available—full or high fat (20 per cent fat and 40 per cent protein); medium fat (5 to 7 per cent fat and 45 to 48 per cent protein); and low fat (approximately 1 per cent fat and 50 to 53 per cent protein).

Soy flour differs from wheat flour in many ways. It is lacking in gluten and very low in starch and cannot be used alone for bread or other baked products. Primarily a protein concentrate, soy flour's principal use is to add nutritive value to other foods.

Soy flour, grits, and flakes are used extensively, not only in the United States but in several European countries, especially Great Britain and Russia, with wheat flour in bakery goods, macaroni, and other paste goods; in soups, candies, ice-cream powders, prepared baking mixes, breakfast foods, confections; and as an extender in various meat products. Soy flakes are used to a considerable extent in the brewing of beer. Other foods on the market are baked soybeans, canned and quick-frozen green-vegetable soybeans, soy butter, bean curd, diabetic foods, meat-like products, milk substitute (liquid and powder), soy sauce, sandwich spreads, and infant foods. In addition to its many uses for human food, soy flour has been successfully used as a pollen supplement in the winter feeding of bees.

Vegetable soybeans, which are now grown in all sections of the soybean-growing region of the United States are being used extensively for shelled green vegetable soybeans in home gardens and by canning and quick-freezing companies.

The soybean has now become firmly established in the industrial world, and the oil produced from the bean has come to fill a highly important place not only in the domestic but also in the international vegetable-oil supply and economy. Nearly all soybeans entering commercial channels in the United States are processed for the purpose of obtaining the oil, leaving a high-protein residue for use as stock feed, flour, and industrial products. Three methods are ordinarily employed for processing soybeans for oil; namely, continuous pressing (expeller and screw presses), hydraulic press, and solvent extraction. At present the use of expeller and screw presses is by far the most common; but in the North Central States, where soybean processing is centralized, solvent extraction is increasing.

Previous to 1935 soybean oil in the United States was utilized chiefly in soap, paint, and varnish. Since that time, however, 70 to 85 per cent of the soybean oil supply has been used in the food industries. Soybean oil possesses a combination of properties that qualify it as an ingredient of a wide variety of manufactured products, such as vegetable shortening, margarine, salad, oil, soap, cleaning compound, disinfectant, foundry oil, paint, enamel, varnish, linoleum, oilcloth, printing ink, grease and lubricating compounds, rubber substitutes, patent and artificial leather, waterproof fabric, glycerin, lecithine, medicinal oil, sticker for sprays, waterproofing cement, pharmaceuticals, cosmetics, food modifier, special emulsifier, petroleum products, plastic compositions, and textiles.

Soybean meal, remaining after the beans are processed for oil, is a most valuable product and has wide usefulness. It is a highly concentrated and nutritious feed and food and is extensively fed to all kinds of livestock, poultry, and fur-bearing animals in America and in European countries. In the Orient the principal use of the oil-meal is for fertilizing purposes—rice and truck crops—but it also serves as a feed for work animals. The industrial utilization of soybean meal is still in the early stage of development, and the tonnage used at present is relatively small. Industrial products in which the meal is used include adhesives, textile fibre (artificial wool), spreader for insect spray, finishing wax, paper-sizing material, celluloid substitutes, plastics, water paint, and waterproofing for textiles.

Although much research has been devoted to the composition of soybean seed, one may say that only its grossest aspects are known and much is yet to be learned of the finer and less obvious details of its chemical structure. A well-known fact is that the seed comprises principally protein (29 to 52 per cent), oil (12 to 24 per cent), fibre (3 to 6 per cent), carbohydrates (22 to 30 per cent), and minerals (3 to 6 per cent). The principal protein of the soybean is glycinin of which the content of amino acids is similar to the value of casein, the principal protein of milk. Soybean oil contains a variety of mixed fatty acid, glycerides, and phosphatides, as well as unsaponifiable materials, such as sterols, ketones, and hydrocarbons. The carbohydrates are present in the form of sugars, cellulose, and various glycosides. Soybeans have a higher mineral content than many other common legumes and grains. The seed also contains many other constituents, such as pigments, vitamins, enzymes, and antioxidant bodies, many of which have never been isolated in pure form. Little is, therefore, known concerning their structure, function, and use. Other substances are undoubtedly present in soybean seed, but only through continued research may their identity and usefulness be known.

The soybean has become one of the most valuable, if not the most valuable, of China's gifts to the Western World. Because of the almost unbelievable multiplicity and variety of uses, it is said that a more versatile plant has never been known to science. With an ever-expanding and amazing versatility, it has risen from a little-known plant immigrant to a vitally important and almost indispensable place in our agricultural and industrial economy. —Reproduced from *Foreign Agriculture*, May, 1948.

NOTES ON COOPERATIVE FARMING

By MANILAL B. NANAVATI

COOPERATIVE farming holds out a great promise, particularly for the overpopulated agricultural regions, as a means to minimizing farm-costs and maximizing agricultural production. But, in practice, the application of the principles of cooperation to farming is a tough task which calls for not only tact and administrative skill but also for a clear understanding of the various issues involved in organizing a cooperative farming society. It is also necessary for the organizers to know about the various factors which aid its progress and others which hinder its development.

The two notes given below have been prepared for the benefit of those who are interested in cooperative enterprise for joint cultivation. Note I is based on two recent publications viz. (1) *Exploring Tomorrow's Agriculture* by Joseph W. Eaton, and (2) *Cooperative Communities at Work* by Henrik F. Infield. It gives the types of such societies and the conditions under which they succeed or fail. Note No. II which is based partly on the experiments narrated in the above-mentioned publications and partly on our own experiences of the Cooperative Movement, shows the conditions under which cooperative farming can succeed in India and the steps to be taken therefor. On a careful study of the existing conditions in India, it will be realized that instead of making a few experiments on a comprehensive basis or along with them, we have to re-orientate the cooperative movement as a whole so as to create ultimately conditions for a widespread adoption of the system of cooperative farming. It is hoped that these two notes would help to make a realistic approach to this important problem which is engaging the attention of the country.

I

PLANNING FOR THE COOPERATIVE FARM

Land

These are the sources from which the land may be secured for the society : (i) Government, (ii) landlords and (iii) members. Where the land belongs to the Government, it may be leased either to the members individually or to the society collectively. Lands from the landlords should be leased by the society on a fairly long term. Where members have their own lands, some more may be taken on lease. if necessary, and all the lands may be jointly cultivated by the society.

Selection of the area

It is hazardous to launch an experiment on lands which are subject to violent climatic changes like droughts or floods. Where the rainfall is precarious, the society must be capable of organizing crop insurance. But it is highly advisable to avoid such areas during experimental periods. In fact, the Society must have lands which are capable of development at reasonable cost and also possess adequate facilities such as roads and means of transport to market its produce.

Membership

The experiments made so far show that the members either (i) belong to a fraternity as in Hutterites[1], or (ii) belong to the same religious order as, for example, the Jews in Palestine, or (iii) are *bona fide* cultivators and/or landless labourers as in the case of the Madras Land Colonization Societies or (iv) colonists or settlers like war veterans with no previous experience of agriculture. It may be noted that the success of the enterprise depends largely on the selection of members, their ability to go through trying times during periods of formation of the Society, their capacity to work for higher cooperative ideals and better living.

Types of cooperation

Cooperation may be either (i) confined to cultivation only, with or without reservation of homesteads or (ii) cover entire agriculture as under collective farming or (iii) may be further extended to purchases and sales and even to social services such as education, hospitalization, etc. along with cooperation in cultivation.

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[1] *Cooperative Communities at Work* by Henrik F. Infield, pp. 8-24.

Management

The internal administration of the cooperative farming may be entrusted either to (a) leaders selected by the members or (b) a specially selected staff for the management and for keeping the accounts and allocating the tasks. The supervising agency, however, may be either (i) autonomous from among the members—leaders of the organization—, (ii) promoters of the movement as in the Delta—Providence Societies[2] or (iii) supplied by the Government sponsoring the movement.

The success of the enterprise will depend upon the ability of leaders to bring about impartial and harmonious working as also upon the tact and qualifications of the supervising agent.

Types of assistance from outside

The members of the Society may obtain help in the form of (i) costly implements on hire from tractor farms as in the U.S.S.R.; (ii) equipment, technical advice and assistance as in Farm Society Administration, including housing facilities; (iii) loans and grants from (a) banks as in case of Mexico, KVUTZA[3], (b) from the Government as in the Farm Security Administration, (c) societies' own funds as in Hutterites, or (d) from the members' own contributions.

Conditions which lead to success

(i) There must be an assured increase in production and income and, if possible, longest seasonal employment, e.g. the Mexican Experiment (KVUTZA) which was successful because most of the members were tenants of landlords and cooperation offered them a distinctly improved income and higher status.

(ii) To ensure harmonious relations among the members, there must be homogeneity of membership or identity of interests, e.g. Hutterites which is a semi-religious body.

(iii) Much depends upon the leadership and the spirit of cooperation of the members. They must be intelligent and more or less of equal status, as, for instance, the Jews in the land settlements in Palestine.

(iv) The work as well as the produce must be distributed equitably, as in the Bulgarian Experiment. This experiment which was initiated for the purpose of cooperative distribution of farm labour, has been superseded by cooperative farm proper. The benefits of this transformation are, economy of labour as well as of expense to the organization.

(v) The members must have the capacity for hard labour and to undergo privations in the early stages.

(vi) The Society must not ignore the need of maintaining individual interests through homestead land and production.

(vii) The members must be helped from outside so as to keep them loyal to the Society.

(viii) Often, the force of circumstances alone suffices to make the members run the Society successfully, e.g. the land settlement in Palestine.

Causes of failure

(a) The grestest danger to the Society comes from the friction between the members and the management, bureaucratic tendencies in the leaders or supervisors, and bad manners of some of the members. The Llano Cooperative Colony founded in 1914, failed because of its faulty plan, discrepancy between principles and practice, inability of the members to put up with the difficulties in the initial stages and low admission standards. 'Dissatisfaction, splits, loafing by some, overwork by others, farm left to scanty operations' are among the other causes mentioned[4].

(b) Some ventures have failed, due to frequent crop failures or fall in prices as, for instance, the Sunrise Community[5].

(c) The Farm Security Administrations Experiment in the U.S.A. failed because the costs were disproportionately high as compared to the results.

(d) Many Societies come to grief due to friction among the members caused by (i) partiality, (ii) incongruity of interests as for instance, where hig landlords as well as mall ones or landless people are members of the same Society, (iii) unequal social status of the members, (iv) differences among women-folk and (v) religious or caste differences.

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[2] *Exploring Tomorrow's Agriculture*, pp. 202-204; *Cooperative Communities at Work, Infield*, p. 174.

[3] *Cooperative Comminities at Work*, pp. 51-78 and 117-142.

[4] *Cooperative Communities at Work*, pp. 25-40.

[5] *Ibid.*

(e) A Society's progress is sometimes hindered where it tries to adhere to rigid and stereotyped rules and by-laws which ignore local customs and conditions.

Conditions under which cooperative farming may succeed in India

1. New land settlements as in the United Provinces under the refugee administration have considerable chances of success, provided the members are *bona fide* agriculturists and are of the same status. Otherwise, they will leave the farm later on when peaceful conditions are established.

2. In special circumstances, cooperative capitalistic farms with membership composed of big landlords may succeed where large funds are required, provided the workers are given a standard wage and share in profits.

3. Where men are of unequal status, men in lower grades may be guaranteed a minimum wage and a minimum income by the Government. This special subsidy is necessary to lower grade workers to ensure their enlistment in the membership of the Society.

4. Where the members are of the same status, the successful working of the Society will depend upon an assured increase in production and net income. This, therefore, requires a thorough survey of the area and an assessment of the possibilities of increased income before the Society is formed.

5. From the organization of the Society to the realizing of noticeable benefits from cooperative farming is a long way. It is, therefore, necessary for the members to carry the project through with great patience and under strict discipline.

6. The Society should be provided with adequate funds in the form of short and long term loans and initial grants for housing and other equipment.

7. Servicing should be near at hand and prompt.

8. New lands should be exempted from assessment until they are brought under full cultivation and become a paying proposition.

9. The Society must be given free service of the Cooperative Department by way of audit and supervision.

10. Guidance should be in the hands of specialists trained in accountancy, works management, agricultural engineering, agricultural technology, etc. These experts must be social but also firm and tactful.

11. Other State assistance such as free service from technical departments such as agricultural, veterinary, public health, etc. in planning for the development of the farm. Red tape and delays in administration should be avoided. The assistance should be wholehearted and the Government must trust the men on the spot.

12. Members must have completely sunk their caste and community differences and be free from village squabbles and local politics.

13. Members must be taught to appreciate the significance and value of the cooperative method. They should be made to realize that cooperative farming does not stand merely for pooling their holdings and giving them wages in proportion to their labour but for certain definite economic and other benefits.

14. The members must have undergone training and discipline in a multipurpose society and have appreciated the benefits arising out of cooperative method.

II

HOW BEGINNINGS MAY BE MADE UNDER INDIAN CONDITIONS

There would be two distinct types of cooperative farming societies: (1) for lands newly acquired or reclaimed and (2) for lands already under cultivation.

Societies under group (1) may be for (a) first class cultivators from congested areas. These may be either cooperative agricultural societies or both, (b) small holders and landless labourers and tenants, (c) men newly taking to cultivation, e.g. retired soldiers belonging to various castes and communities. Societies under group (2) should be for (i) first class cultivators in the village and (ii) small holders and tenants pooling their resources together.

Each of the above type would require different treatment and assistance. Societies of landlords and big cultivators, for instance, would need loans for housing. Small holders and tenants would need guidance and help almost at every step until the society gets into satisfactory working. Non-agriculturists being settled on land are apt to take up the work half-heartedly and provision, therefore, will have to be made to give them adequate training to make them efficient cultivators.

There is no denying that some of the factors hindering the development of cooperative farming obtain in India and would present serious obstacles to progress in this direction unless we have a systematic plan for the formation and working of such societies.

Societies under (a) will succeed only under extraordinary conditions with a very reliable leadership and with members who have absolute faith in their own ability to develop agriculture as also in the advantages of the cooperative method.

Looking to conditions in India, two distinct methods may be adopted to popularize cooperative farming (a) to form cooperative societies where conditions look favourable and results almost assured and (b) to prepare the ground for cooperative farming so that in course of time people themselves come forward to form such societies, having had their apprenticeship in the working of cooperative methods in various directions and appreciated the benefits of joint working.

As for (b), it is highly desirable that attention should be paid to formation of multipurpose societies all over so that the scope of their working can be widened to include farming subsequently when the members have fully realized the benefits of cooperation and would be prepared to stick to the movement under all circumstances. Our approach to cooperative farming, therefore, must be from two sides; where possible, the agriculturists may directly combine and form a cooperative farming society; in other cases, the members may be asked to form cooperative associations with less ambitious aims and objectives and then gradually develop the societies until they are capable of taking up cooperative farming. The various stages in this development may be as follows:

(1) Cooperation in a business, i.e. for purchase of farm requirements; and in agriculture, sale of farm produce and finance and cooperative ownership of costly implements and other farm equipment, and in improvements in the technique of agriculture and provision of some social services.

(2) Cooperation for consolidation of holdings.

(3) Joint programme of cultivation—each member cultivating his own farm but according to a plan agreed upon by all members.

(4) Joint cultivation of all farms. We may call it collective farming.

Each of these stages, would in practice vary considerably in its details. To help the societies to develop in this order, the Government must maintain a specialized staff. If cooperative farming is to spread on any appreciable scale, the whole of the cooperative movement would have to be reorientated with this end in view.

While the shift of emphasis from credit to multipurpose type of societies would create the necessary atmosphere for the formation of cooperative farming societies, further measures would be necessary to help such societies to come into existence and to assure their smooth progress. The most important of these measures are as follows:

1. A special study of the agricultural conditions of the locality and to find out what definite and marked benefit would accrue from the enterprise. A distinct gain must be established, such as larger and better realization of values through collective sales. Otherwise, most of the members would hesitate to pool their resources and consider the venture as a leap in the dark.
2. The law of inheritance would have to be modified to prevent actual sub-division and fragmentation of holdings; otherwise, the cooperative farm would be lacking in stability.
3. To find out men from the village and outside who will be able to keep proper cost accounts and task assignments to members.
4. To collect such implements as would increase production and take them on lease as from a Government Farm.
5. To prepare land surveys for realignments of fields. Before this is done it is advisable to consolidate the holdings and rearrange them. It would be easier to realign consolidated holdings than scattered ones. This will reduce capital investments to the minimum.
6. To obtain Government assistance for (2), (3) and (4) and arrange for loan, subsidies and finance, if the society has not got funds of its own or is unable to borrow from its own bank. Government's help and guidance must be prompt, business-like and near at hand.
7. Government should appoint superior staff for guidance and advice to ensure that the societies work according to plan and that mistakes are discovered in time. The local staff engaged to work relating to accounts, agricultural technique, farm management, etc. should be well-paid as the success of these

societies largely depends upon their efficiency and zeal.

8. Arrange for agricultural programme including crop rotation, new crops, manuring and irrigation.

9. Assignment of work among members, selecting leaders or appointing committees for management.

10. Organization of subsidiary industries to help members of the cooperative farming society to supplement their farm income.

11. Development of social services along with joint cultivation so that the men get the full benefit from cooperative work. Every aspect of social work should be attended to: health, sanitation, education and entertainment. Reduce the drudgery of the women in the villages and thus enlist their cooperation. Develop their dairy industry and instruct them in their domestic sciences. If a woman worker could be engaged to help them, it would serve as a stimulus in getting the cooperation of the women-folk in the new venture.

12. The most essential factor in cooperative farming is that every step should be taken to ensure a definite increase in production because, otherwise, in the case of a fall in the yield, the members would cease to be loyal to the society. Necessary measures, therefore, should be taken to prevent crop failures. These measures may take the form of irrigation or/and larger areas being made available to the society to provide an insurance fund.

13. The most difficult problem would be to get the cooperation of the landless workers or the small holders. It should be made worth their while to join this society. Landless workers should get their fair wages and a small holder a decent return. Possibly in the initial stages an adequate income should be guaranteed by the Government to both these classes. It is they who need the utmost help and they should be induced to join the society.

14. Fall in agricultural prices has been responsible for the winding up of many cooperative farming associations. Experience during the last depression has demonstrated the disastrous consequences of fall in prices on Indian agriculture. Stabilization of agricultural prices, therefore, is a fundamental requisite to the development of cooperative farming.

The success of any venture depends largely on the human factor—the integrity and ability of the men behind it. This fact cannot be overlooked while forming associations for cooperative farming. Normally, every individual likes to work alone in his own domain and would not like to surrender even a part of his individualism or economic freedom to any association, unless he is assured of a material gain. Hence, the importance of a preliminary survey of the possibilities of increasing the farm income before forming the society. This also brings out the necessity of selecting the members, since those who have no faith in cooperative ideals or who have not been trained to work according to cooperative principles would only shirk their duty and lead the society to disaster. Where the cooperative society has developed stage by stage, the multipurpose cooperative society would have provided the necessary apprenticeship to the members and qualified them for running the cooperative farm. But in other cases, all possible care would have to be taken to ensure that the indifferent, or diffident people are kept out of the society. Cooperative farming would succeed only where each of the members is not only experienced and trained in the cooperative method but also imbued with hope, courage and determination to contribute his maximum to the working of the Society.

We are all agreed that cooperative farming is a very complicated undertaking and a costly experiment. It should, therefore, get guidance and support from a very efficient administrative machinery from the very start. A cooperative farming society will need assistance from at least three departments of Government, Cooperative, Agriculture, and a Department concerned with land consolidations. Therefore, there must be a perfect harmony among these agencies, specially between the first two which will have to work together all along the career of the society. Usually no two departments of Government cooperate with each other and therefore, most of our efforts fail or do not get the results expected of them. At least that is the experience in the working of the cooperative movement. Therefore, whichever Department is entrusted with the administration of the cooperative farming (though in the natural course the Cooperative Department should have the preference), that Department should have a specially qualified staff to make the preliminary surveys, to prepare schemes for farming and to see that the programme works to the plan. For these purposes it shall not have to depend upon the Department of Agriculture for advice and guidance. If we want to avoid mistakes of the past, this is one of the conditions precedent to the largescale formation of cooperative farming enterprises.

Cooperative farming is one of the items in the programme of land reforms to be carried out in India. The central idea in the land reform movement is to create economic peasant farms. To that ideal our energies are to be directed. The programme for this can be summarized as under.

1. Declaration of all land as State property; elimination of intermediary interests in land; land to be given to actual cultivators with occupancy rights, with restrictions on their right to transfer and subdivide the holding.
2. Each occupancy holding to be an economic unit and as far as possible, in one consolidated block.
3. Making the farmer live on the farm or as near to it as possible.
4. Prohibiting the use of land as security for non-productive purposes.
5. Cultivation of the land by the man who owns it, or has the occupancy right.
6. Abolition of share cropping and its substitution by low cash rental based on a certain multiple of Government rent and correlating rent with price levels.
7. Assessment on land to be graduated, uneconomic holdings paying less or nothing; agricultural incme-tax to tap more revenue from the larger groups.
8. Regulation of land values on the basis of yields, abolition of speculation in land and provision of cheap finance for cultivators who want to own lands and cultivate them.

This programme would require a good deal of legislation and take time to bear fruit. In the meanwhile, cooperative farming may assist in some selected areas, to help the cultivators, though it would be very difficult to assist small tenants and uneconomic farmers to improve their lot unless they are bodily removed to some more remunerative employments. Cooperative farming for these classes alone would be almost impossible of achievement as they would be too many for small areas owned or cultivated by them, unless larger areas owned by absentee landlords are leased out to such societies, so that the area of the cooperative farm is sufficiently enlarged.—Reproduced from *The Indian Journal of Agricultural Economics*, September, 1948.

Book Reviews

LAND AND FOOD PROBLEMS OF BIHAR

By Jamuna Prasad Sinha (Published by the author, pp. 107, price not mentioned).

THE author has dealt with the problem of land utilization and food production in Bihar. Mr. Sinha is a member of the Food Grains Committee of the Indian Council of Agricultural Research and has got a clear idea of the problem. He rightly points out that 'The necessity of the country demands intensive cultivation on a scientific line on a small as well as on a large scale'. The author believes in the peasant-proprietorship of land. He suggests that 'the estates should be taken charge of as soon as possible in the interest of peace and order and to save the estates from further deterioration and ruin'. All persons according to him, holding lands in excess of 100 acres in any capacity must give up possession and hold up the 100 acres only. It is pointed out that in these conditions about one lakh rent suits and other suits relating to land in the province will disappear. With the vesting of peasant-proprietorship in land greater incentive will be created in the peasants, which will result in more production and better yield. Moreover, land reforms like consolidation of holdings and land improvements will be more readily, easily and voluntarily made.

The author points out that mere abolition of *zamindari* system will not be enough. He feels that India is ripe for consolidation of holdings by legislation but is not ripe for co-operative or collective farming. He has put a maximum limit of 100 acres and minimum limit of 25 acres as the size of an economic holding necessary to maintain an average family of five persons employed in agriculture. These figures appear to be on the higher side.

The author has been very critical about the 'grow more food' campaign work in the province. Regarding the food requirements of the province, he points out that for the population of 40 millions, the total requirements including seed, animal food and wastage in storage is 20·50 crore maunds of cereals per year. In a normal year, however, the production does not exceed 17 crore maunds. The deficiency of 3·5 crore maunds, he suggests, may be made by either of the following ways:

(1) By increasing the yield of crops in 1·75 crore acres of cultivated land by two maunds per acre, by irrigation and double-cropping.

(2) By bringing one crore acre of easily cultivable or cultural fallow land under plough or cultivation and growing 3½ maunds of grain per acre in them.

(3) By properly utilizing the forests and growing useful trees like *mahuwa* and others in place of useless trees.

The author recognizes the use of tractors for breaking the land for reclamation of *parti* land but does not feel that it is paying for day-to-day agricultural farming below 100 acres of land.

Irrigation schemes like long term or big schemes and short term or small schemes in the provinces have been discussed. The necessity of converting the *kutcha* wells into *pucca* wells in the Patna Division has been stressed. Stress has been laid on popularizing green manuring by *sanai* and the preparation of compost from cow-dung, nightsoil, farm-yard sweeping, leaves of plants, etc. The introduction of quick-growing fuel plants to take the place of cow-dung cakes has been advocated.

The author has touched the problem of better bullocks and better seeds. The starting of model farms in each district has been suggested. The smallscale farm will consist of 25 to 100 acres of land cultivated with the help of bullocks and the largescale farms will consist of 200 to 1,000 acres or more of land ploughed by tractors. These largescale farms will also deal with dairy farming, sheep or goat farming, poultry farming, fish farming, vegetable farming, and fruit farming.

The author has laid stress on the preparation of a soil map for each district on the basis of which the farming of the cropping scheme should depend.

The need for the liberal provision in the budget for the agricultural development is indicated. The author has suggested that the necessary amount could be raised by taxing the mill-made commodities such as rice, pulse, flour and oil at Re. 1 per maund, and the hides exported from Bihar at Rs. 2 per hide.

The problem has been discussed in a lucid manner. One gets a good idea of the food and land problems in Bihar by reading this booklet. The views set forth in the booklet merit close consideration. (S.P.R.)

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COOPERATIVE DEVELOPMENT IN THE UNITED PROVINCES

(Published by the Cooperative Department, United Provinces, Lucknow).

IN the brief space of 40 pages an attempt has been made in this monograph to indicate the essential features of the Development Coordination Plan of the U. P. Government, put into operation since April 1947. The project is interesting and the organization of 10,000 cooperatives with a multipurpose base in 900 development blocks covering 14,000 villages is not apparently without its promise.

But, disillusionment comes too soon when one reads that their 'sole aim, for the present, is to effect a considerable increase in the production of cereals, milk, *ghee* and cloth'. One can only wish that it is not all correct and the new cooperatives will not simply differ in name only from the existing Government seed stores. To make cooperation a living force in the village community life the societies will have to be truly broad-based with an ever-widening sphere of activity until their functions are in equilibrium with the needs of development and construction of a progressive group.

The monograph has been made attractive by the many illustrations contained in it although there is much to be desired in its printing and get up. (B. S.)

SNIPPETS ON FOOD AND AGRICULTURE

1. The total procurement of foodgrains in 1948 amounted to 24,84,000 tons, as against 18,42,200 tons already procured this year.
2. If India's 5 crores of date palms and palmyra trees were properly exploited, 50 lakhs of Indian families could be profitably employed.
3. The average annual production of the *kharif* foodgrains in India for the five years ending 1947-48 was 31,972,000 and of the *rabi* foodgrains 11,435,000 tons.
4. A subsidy of Rs. 26,52,00,000 is estimated to be paid by the Government of India during the financial year 1948-49, for providing the sale of imported foodgrains to the public at rates lower than cost price. (*P.I.B.*)

News and Views

LIVESTOCK ON BRITAIN'S FARMS

By JOHN HARRIS

BRITISH cattle are found in almost every country in the world. Some of the breeds—Shorthorns, Ayrshires, Aberdeen-Angus, Herefords, to name only four—are native to the United Kingdom. Others, like British Friesians and the Channel Island dairy breeds, came from nearby countries originally, but have been developed in Britain.

Since World War II, there has been a vigorous demand for British cattle from overseas buyers, and the exports in 1947 were twice those of 1938 in volume. The great meat-producing countries of South America have found it necessary to return periodically to the stock farm of the world in order to rejuvenate the blood of the vast herds in those lands. Thus, buyers from South America and the U.S.A. have been busy in the last three years and the urgency of their requirements is clearly instanced by the willingness of one American buyer to pay £15,225 (Rs. 2,03,000) for a Shorthorn bull at the world famous Perth Sales, in Scotland, in 1946. Dairy cattle also are being exported in bigger numbers.

Before referring to the characteristics of some of the many breeds which have given Britain her pre-eminent position as a breeder of the finest type of stock, it may be of interest to mention one or two of the main trends in the cattle industry at the present time.

Expansion of dairy industry

As compared with the situation 10 years ago, the outstanding change has been the expansion of the dairy industry. Milk production received every possible official encouragement during Warld War II and the response of British dairy farmers was remarkable.

Milk sold for liquid consumption is today 50 per cent above the 1939 figure and milk consumption per head of the population has gone up from 0·43 pints per day to 0·67 pints. The number of cows kept for milking and rearing is, at about 2,800,000 for England and Wales alone, five per cent above the pre-war level.

Another recent development is the response to artificial insemination, subject of the recent Milan conference. Centres have been established all over Britain and at those operated by the Milk Marketing Board alone, the number of inseminations carried out grew from 25,000 in the year 1946-47 to over 90,000 in 1947-48.

De-horning becoming common

De-horning of cattle, too, is becoming far more common, calves either being treated when young or the horns removed under an anaesthetic from mature animals. Cattle without horns are especially well-suited to being kept in yards and, in order to reduce labour and capital costs, the practice of housing dairy herds in yards, rather than in an elaborate and expensive cowshed, is now to be found on a large number of farms.

As regards the cattle themselves, there are in Britain five purely dairy breeds. First in numerical importance—representing nearly one-quarter of bulls of all breeds licensed for use in breeding each year in England and Wales—are British Friesians. This breed came, of course, from Holland and its increased popularity in Britain has been perhaps the outstanding development in pedigree stock of the past quarter of a century.

British Friesians are famous for the quantity of their milk. In many herds cows giving 20,000 pounds of milk in a lactation will be found. A large number have reached 30,000 pounds, and in 1948 one cow gave 45,000 pounds of milk in 365 days—a world record for any cow of any breed. Friesian breeders are concentrating their attention upon raising the butter-fat content of the milk and have achieved a large measure of success. In the year 1946-47, some 3,500 herds of this breed

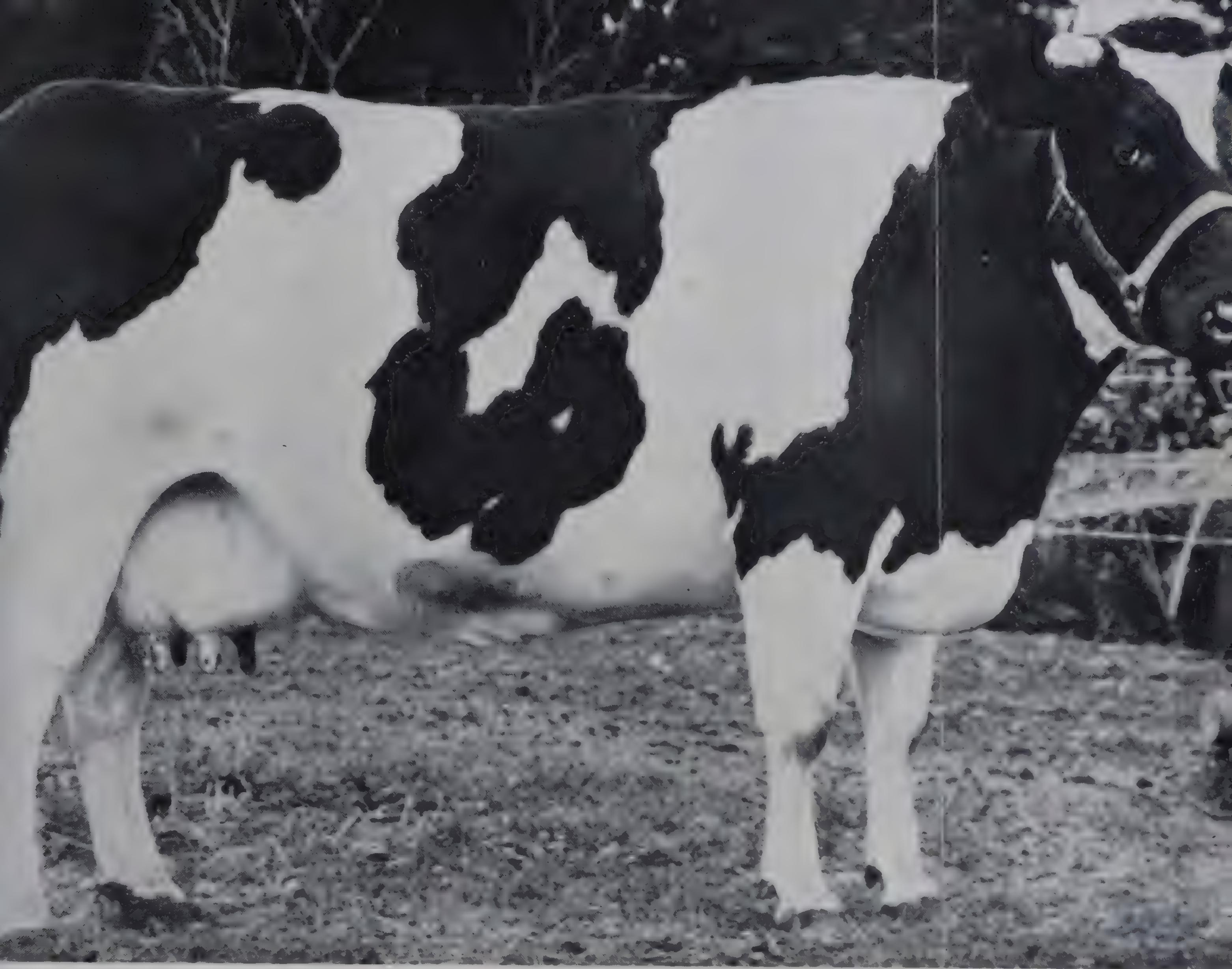

FIG. 1. British Friesian cow 'Bridge Birch' which in 350 days gave 44,289 lb. of milk, a world record yield.

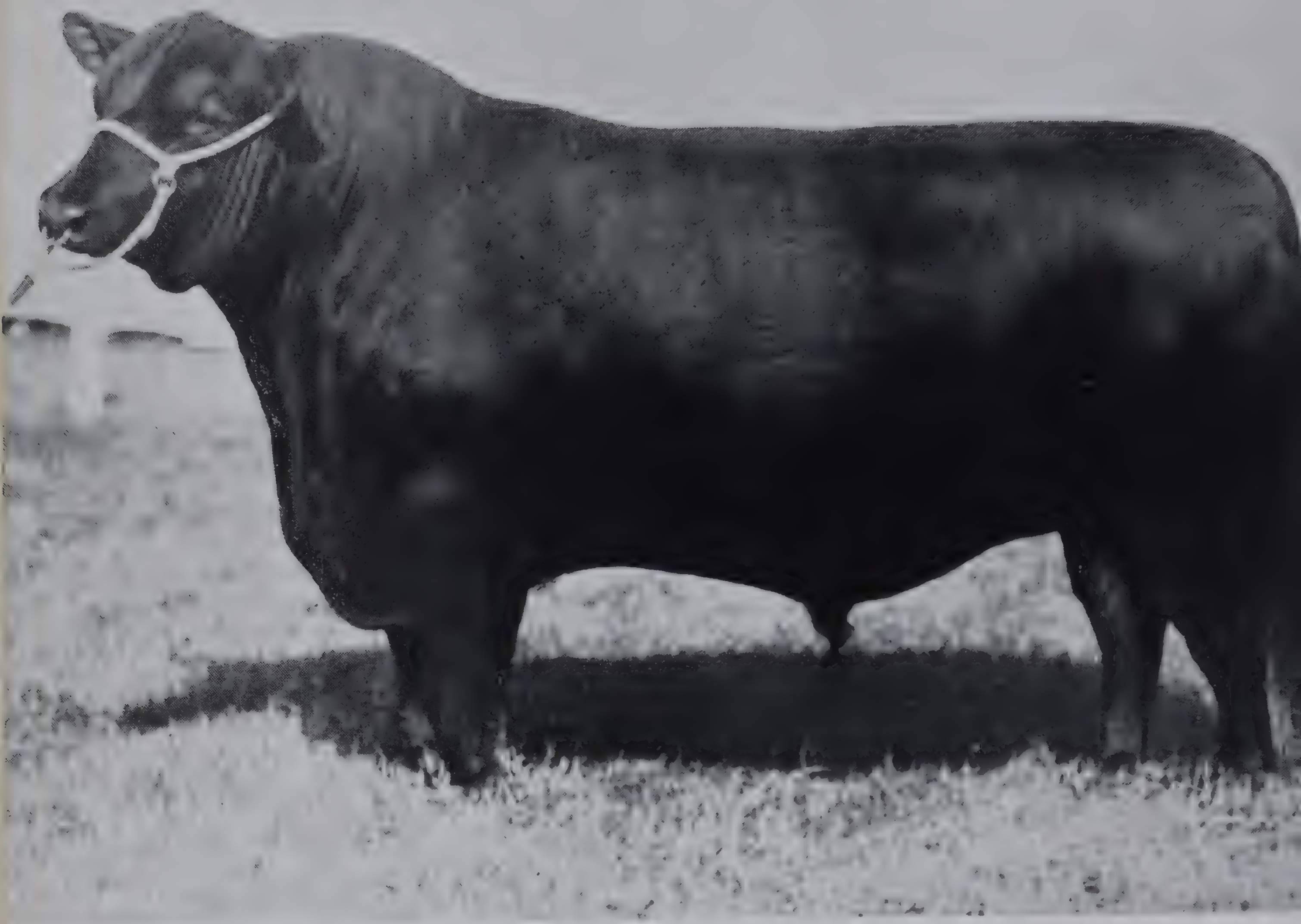

FIG. 2. ' Pelorus of Bywell ' of the famous Aberdeen-Angus breed.

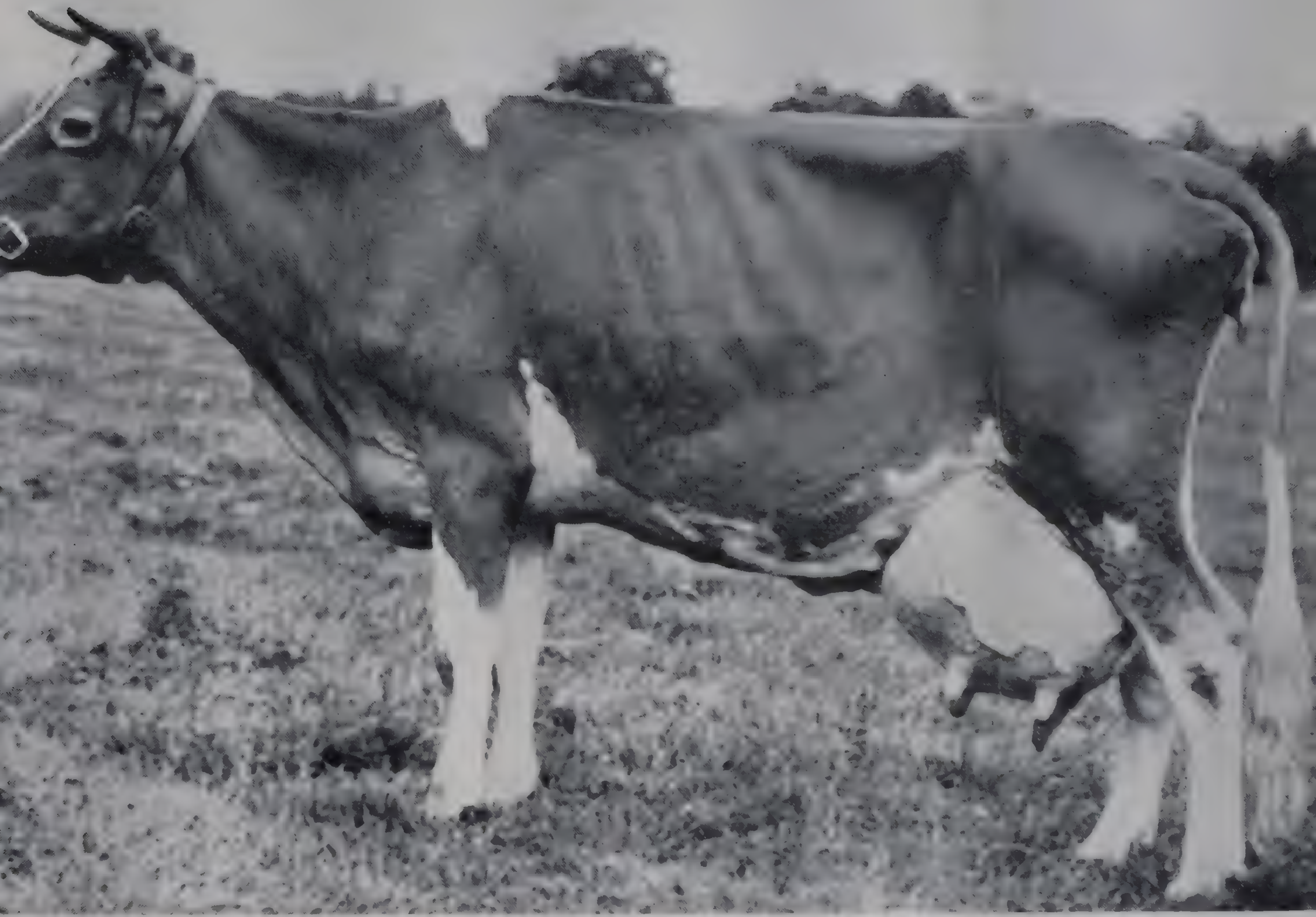

FIG. 3. 'Hazelby Fancy', a Guernsey cow, produced 25.305 lb. of milk in 360 days with 4·43 per cent butter fat.

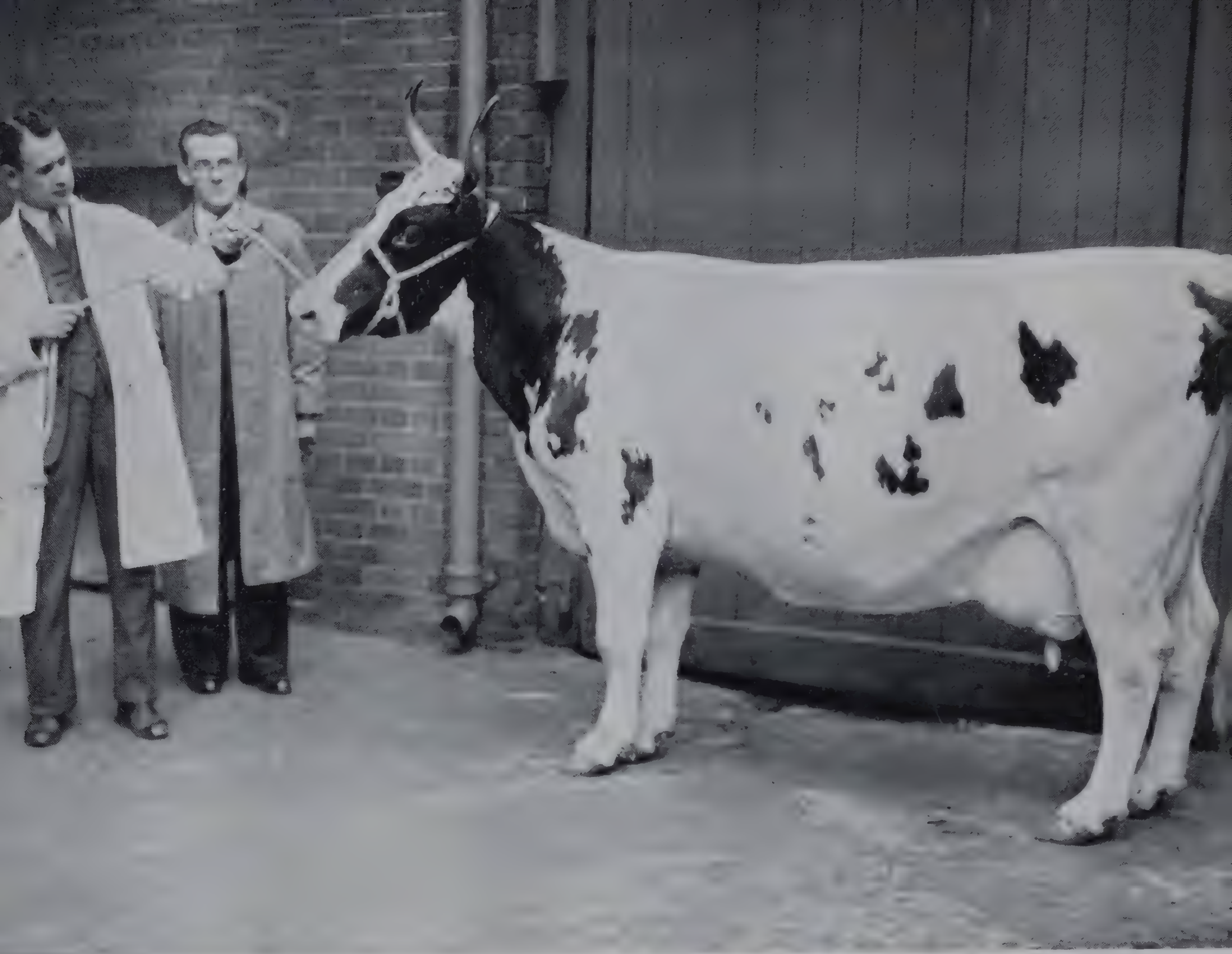

FIG. 4. 'Bargower Cherry 29th' (Ayrshire), the supreme champion of the Dairy Show at Olympia.

were officially milk recorded. The average yield for cows was 8,555 pounds, with an average butter-fat percentage of 3·45.

Channel Island breeds

Milk of a high butter-fat content is now paid for at a special rate in Britain and this fact has been to the advantage of the two Channel Island breeds—Guernseys and Jerseys. The fame of the Guernsey is based upon the richness of her milk, the average butter-fat percentage in the leading herds is over 4·5.

There is a tremendous demand for Guernsey cattle in Britain at the present time. In September, 1948, one exceptional herd of 27 pedigree animals sold at an average of £718 (Rs. 9,573) and on one day of the official sale of the Guernsey Society (September, 1948), 97 pedigree cows and heifers were sold at an average of £301 (Rs. 4,013).

Jerseys have an even richer quality milk, if butter-fat be the guide, than Guernseys. Being smaller cattle their average yield (for recorded herds about 6,700 pounds) is rather lower but it can truly be said that small cattle need less food and Jerseys compare favourably on a pound for pound basis, with any breed. They have been exported to almost every country.

Free from tuberculosis

A dairy breed native to Scotland is the Ayrshire, most famous for the excellence of her udder. There are a very large number of 'attested' (free from tuberculosis) herds of this breed and their freedom from disease has led to a keen demand for the cattle in recent years. In point of production, the Ayrshire comes second of the pure dairy breeds, the recorded herds in England and Wales averaging some 7,500 pounds of milk. A regular output of 10,000 pounds of milk every year with butter-fat at four per cent is the performance claimed for this breed.

The Shorthorn represents the most numerous breed of cattle in the United Kingdom. Nearly half the bulls licensed annually in England and Wales come under this category. In fact, however, the term 'Shorthorn' covers two distinct types which are most conveniently dealt with as two separate breeds—Dairy Shorthorns and Beef Shorthorns.

Recorded herds (that is, where milk yields are recorded under the official scheme) of Dairy Shorthorns in England and Wales are equal in number to the next three breeds combined and wherever the visitor may travel in Britain he will come upon Dairy Shorthorns. The breed has proved its suitability for almost any conditions.

Dairy Shorthorns

From the standpoint of the potential buyer, Dairy Shorthorns have the advantage of being less expensive than many other pedigree dairy cattle. The overall average for 3,500 pedigree animals sold at the big collective sales in 1947 was £92 (Rs. 1,227). This remark still holds good, although at the 1948 Spring Show of the Shorthorn Society, pedigree bulls made the highest average ever for this fixture (£200 or Rs. 2,666 for 99 head). Dairy Shorthorns have proved their ability to thrive in the Union of South Africa, Canada, Australia, New Zealand, Kenya, the U.S.A., Argentina and Denmark.

Mention has already been made of the growing practice of de-horning. We come now to one of the British breeds which are naturally hornless, the Red Poll. These cattle originated in East Anglia, where they are found chiefly, and are dual-purpose—that is to say they are good producers of both meat and milk.

There are several other dual-purpose breeds evolved to suit conditions in a particular area. They include the South Devon, found as its name implies, in South-west England, and claimed to be triple purpose, for, added to milk and meat is a high butter-fat content, which enables the milk to earn the Channel Island premium. Welsh Blacks are some of the hardiest cattle and in their native Wales produce milk where few other breeds could.

It is generally a surprise to overseas visitors that so many breeds have survived—and this is even more true of sheep than cattle. It will be found, however, that each type of cattle is suited to a certain set of conditions and a breed remains only because of its usefulness. It would be difficult, indeed, to find conditions for which one of the great British cattle breeds was not fitted. (*B.I.S.*)

FOURTEENTH INTERNATIONAL VETERINARY CONGRESS

THE first session of the Fourteenth International Veterinary Congress will take place at 10.00 hours on Monday, 8 August, 1949, and the Congress will last until Saturday, 13 August inclusive. The meetings will take place at the Central Hall, Westminster, and in Church House, Westminster, London, S.W. 1.

Programme

General Meetings :

1. The World Food Situation.
2. The Veterinary Profession's Contribution to the World's Meat Supply.
3. The Veterinary Profession's Contribution to the World's Milk Supply.
4. The Veterinary Profession's Contribution to the World's Poultry and Egg Supply.
5. The Veterinarian and the Breeding and Rearing of Animals.
6. Veterinary Education and its Application to World Problems.

Sectional Meetings :

1. *Animal Health and Animal Parasites.*
    - (a) Protozoal Diseases and Therapeutics.
    - (b) Helminth Diseases and Therapeutics.
    - (c) Arthropod Diseases and Therapeutics.
2. *Animal Health and Bacteria :*
    - (a) Bovine Mastitis.
    - (b) Brucellosis.
    - (c) The Control of Bovine Tuberculosis in Various Countries.
    - (d) Other Aspects of Tuberculosis.
    - (e) Salmonella.
3. *Animal Health and Viruses :*
    - (a) Foot-and-Mouth Disease Vaccination.
    - (b) Equine Infectious Anaemia.
    - (c) Teschen Disease.
    - (d) Newcastle Disease.
    - (e) Swine Fever.
    - (f) Rinderpest.
    - (g) Coryza in Poultry.
    - (h) Rabies.
    - (i) Swine Influenza.
    - (j) Other Virus Diseases of Cattle and Horses.
4. *Physiology and Animal Health :*
    - (a) Animal Health and Mineral Metabolism:
        - (i) Copper Deficiencies
        - (ii) Mineral Metabolism
    - (b) Acetonaemia.
    - (c) Vitamins.
    - (d) Infertility.
    - (e) Endocrines in Relation to Animal Reproduction.
5. *Husbandry and Animal Health :*
    - (a) Plants as Animal Foodstuffs.
    - (b) Husbandry Problems and Production.
    - (c) Genetics.
    - (d) Artificial Insemination.
6. *Animal Health and Veterinary Surgery :*
    - (a) Major Surgery on the Farm.
    - (b) Anaesthesia.
    - (c) Electro-Cardiography.
7. *Animal Health in Relation to Public Health :*
    - (a) Control of Animal Products Intended for Human Consumption.
8. *General :*
    - (a) Veterinary Education.

Note: One day to be devoted to discussions on clinical subjects of particular interest to small animal practitioners, will be held in conjunction with the National Veterinary Medical Association of Great Britain and Ireland.

Films on veterinary subjects will be shown during the week.

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reclamation project in the East, outside Russia. Already the results and outturn achieved in the United Provinces and Central Provinces have been beyond our expectations. The Government have also a project of tube-wells, the details of which are under fresh examination. When implemented, the land perennially irrigated by these deep wells will make a material contribution to meeting our food deficit. The Government also intends, pending the development of indigenous resources of organic and chemical manure, to secure from outside special quantities of fertilizers for use in irrigated rice areas to make a substantial addition to our rice crop. It is also the intention of the Government to save some extra acreage from surplus crops and divert it for the production of cereals. These are the several items in our programme up to the end of 1951.

For the speedy implementation of the revised programme, the Government have decided to set up at the Centre a small Development Board and will request the Provinces and States to set up parallel Development Boards so that the normal departmental procedure may not delay the progress of the programme. The Boards would have attached to them statistical sections to keep continuous contact with developments and assess periodically the results achieved in terms of the targets.

All these parts of the revised food programme were fully discussed with the representatives of the Provinces only a few days ago and provincial plans of production were formulated which would wipe off our food deficit of only about 10 per cent by the end of 1951. The goal before us, therefore, is to achieve self-sufficiency in food by the end of 1951 and we must somehow achieve this goal. It gives me pleasure to state that the provincial representatives felt confident that the programme chalked out with their cooperation could be successfully achieved within the above time limit of December 1951. They, however, needed and rightly the help of the Centre in the shape of more iron and steel, cement and coal, and above all proper transport facilities. The question of how the movement of these materials for food production could be upgraded is to be decided shortly by the Government. But in the meantime, the Government have decided to have a special Liaison Officer who would keep the link between the Centre and the Provinces and States in regard to these matters and see that no difficulties arise in the way of speedy implementation of the new programme. The Government have also felt the necessity of more frequent contact with the Provincial and State plans for production and it has been arranged that there would be a monthly meeting of the officers of the Centre and of the Provinces and States to ensure that the various production plans are being rapidly proceeded with and also to provide an opportunity for fullest inter-provincial coordination. There would be besides a six-monthly review of the progress made in terms of a six-monthly phased programme. I have no doubt that the Provinces and States, realizing the gravity of the situation, will fully respond. Apart from this programme for increasing the production of rice, wheat and other cereals so as to achieve self-sufficiency by the end of 1951, the Government have also decided to encourage the development and use of such high-yielding non-cereal food crops as bananas, papayas, sweet potatoes and tapioca. These have good food value and the yield per acre is many times more than in the case of cereals. Some adjustment also in our habits of diet is essential in the present times.

The Government, however, realize that no plan of agricultural production can succeed unless it secures the cooperation of the agriculturists. It is, therefore, intended, apart from other steps that have to be taken, to organize farmers' unions under the leadership of progressive cultivators in each area so that democracy in the field of production may achieve the greatest results. Public policy in regard to the rural areas needs to be reoriented. With increased agricultural production is linked not only the cultivator's own purchasing power and therefore his standard of living, but with it is linked also our country's economic freedom.

All of us, The Government no less than the House and the public, feel that we must end the crisis which faces us on the food front. We must be independent of food imports by the earliest possible date. A reasonably early date has now been fixed. It is a challenge to all of us. But the challenge can only be met if the food front is looked upon really as a war front, and if the same sense of u gency and emergency which inspires a successful war effort also inspires our plans of food production.

It is not an easy task which the Government has set for itself. We may not take it lightly. It is a hard task needing continuous, persistent, patient, laborious work. It would need the greatest effort by all of us, both Government and the people. The maximum cooperation between the Central and Provincial and State Governments on the one hand and the nation's producers on numberless fields on the other will alone enable the country to reach the goal we have placed before ourselves. I feel confident that that cooperation will be available.

In placing this programme before the House, I would have wished to say nothing which may be regarded as of porsonal nature but I cannot help saying only this much that I wish to assure the House that every ounce of my energy will be devoted to pushing forward the programme to timely success. I may also in conclusion express the hope that Hon'ble Members of the House who have ample influence in their respective Provinces and States will severally treat the programme as their own and give the Government their cooperation in reaching our goal by the target date of December 1951.

Original Articles

SCOPE AND METHOD OF RESEARCH AND TEACHING IN AGRICULTURAL ECONOMICS IN INDIA-II

By T. G. SHIRNAME

UNTIL very recently, marketing of agricultural products formed a very small part of agricultural activity in India. With the opening of the country for domestic and foreign trade during the last eighty years or so, commercialization of agriculture has assumed great importance and the practice of raising special crops which the farmer exchanges for food, clothing and other material requirements in a market is gathering force year after year. The specialization in production has made the question of marketing of vital importance to the farmer and it is now generally recognized that his prosperity depends not only on an increase in the rate of his production but also on his capacity to dispose of his goods at an advantage. Again, this specialization in raising commercial crops, which are exchanged for necessities, has given rise to the other aspect of marketing, namely, the purchase of necessaries.

Marketing of agricultural products

On account of diversity of production in agriculture, there cannot be one method of marketing for all products and hence there is no one clearly defined method which will enable one to understand the whole problem of agricultural marketing. Each product has its own problems and the method of marketing varies not only from commodity to commodity but also from one region to another for the same commodity. The marketing of each commodity has, therefore, to be studied separately and a whole series of investigations, on a commodity basis, is essential to understand the whole problem of agricultural marketing.

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Though each product may have its own marketing characteristics, a rough classification of agricultural products may be possible in so far as the broad marketing features are concerned. Thus, for instance, relatively non-perishable products like cotton, wheat, jute, rice and oilseeds, represent a group which is more susceptible to 'orderly marketing', characterized by a large season to season carry-over and for which there exists a complex system of national and international marketing for dealing with spot and futures transactions. There are besides other non-perishable products like small grains and millets for which the demand is entirely local, there is no international or any well-organized future market, but where the seasonal carry-over, the country-wide production, and the prosperity of the consuming areas are still important in determining the prices received by the farmer. Perishable commodities like vegetables and fruits present a distinctly different problem and require more intensive study than the others. Here the seasonal carry-over is not important and the outstanding characteristic is perishability, price variability and seasonal variation in supply.

The objects of commodity marketing study are: (a) Description of the agencies and mechanisms through which the commodity passes from the producer to the consumer; and (b) the analysis of the factors which make up the supply of and demand for a given product, the measurement of their relationships and explanation.* The purpose of the first objective is to study the efficiency of the agencies and processes involved in the distribution of the commodity, while in the case of the second the study of the factors affecting the commodity prices is the chief aim.

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* Many commodity studies provide a description of the geographical distribution of production, but this may only be the case because no other such statement is obtainable. Where, however, there are differences in type or quality of one commodity from one locality to another, it may be necessary that marketing investigation should include some study of these primary conditions.

Marketing investigations cover a wide field—much wider than is ordinarily thought of—and the investigator who has had a thorough training in economic theory, especially the theories of value, statistical methods and a theoretical and practical knowledge of the conditions under which the production and sale of the commodity are carried on, is best equipped for the work. Indeed, it may not be practicable for one investigator to be an expert in the knowledge of all the important aspects of marketing and specialization may be found necessary where it is desired to conduct investigations in great detail.

In the developmental stages of marketing study, description may receive the largest attention since information descriptive of the structure and processes of marketing form the very foundation to suggest specific research problems. It is true that mere description, oftentimes, falls short of yielding the information or understanding which is required to improve a function or to remedy a situation, but preliminary descriptive surveys are the only means for pointing out the various aspects of marketing that require special study by themselves.

The description of market agencies and mechanisms may cover but a single area or may deal with the whole national or world-wide system. This part of study is concerned with describing the present organization and evolving means for its improvement by examining the efficiency of the different channels of distribution and pointing out wastes and losses. The analytical part of the study consists of the quantitative study of prices, sources of supply, elasticity of supply and demand, areas of production and consumption and all forces that lie behind the determination of market price. The analytical knowledge may serve as a foundation for forecasting future prices and for supplying a rational basis for deciding on the most effective programmes of marketing and production.

Farmers not only sell but also purchase and this side of marketing must not be overlooked. In tracts where cash crops predominate, the prosperity of the farmers, in so far as marketing problem is concerned, depends not only on the efficiency of the organization through which their products pass ultimately to the consumers, but also on the efficiency of the organization through which they buy food*, clothing and materials for the farm and farm family.

The aim in studying marketing is not necessarily one of defence of existing things, nor of advocacy of other things; but either may be justified under certain conditions. Perfection in market systems depends on the attainment of the best possible relations between the functions and agencies and on the development of adequate market information. † During the course of an investigation, the investigator may come across examples of too many middlemen, unfair transactions, manipulation, speculation, improper grading, inadequate transport and storage facilities, but it may be pointed out that each of these may require a special investigation before reliable judgments could be formed. Another point is that the whole marketing machinery is a product of evolution and any improvement must continue to come through gradual improvement of the method and procedure by development of public information and opinion. The first essential is the continuity of all the necessary processes of marketing, for any dislocation of organization must lead to undesirable if not disastrous results.

Social economics of agriculture

The social economics of agriculture may be

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*Under a system of commercial agriculture it is not the practice to treat family (living) expenditure under agricultural economics. This may be treated under rural sociology, or under consumption economics. But under a peasant system, the expenditure of the family for living may be, and often is, the greatest part of purchases. Where the organization supplying *farm* requirements also supplies *household* requirements, it may be desirable to treat both under purchase of requirements.

†Some of the tests by which marketing organizations may be judged are:

(1) Degree of physical wastage of commodity.

(2) Provision of information on supplies, movements of supplies and prices.

(3) Cost.

(4) Service for the maintenance or increase of demand. Under the last, service in storage, grading, packing, selection of supplies for given markets, are becoming important. But cost is not by any means the sole test.

taken to include that part of agricultural economics which deals with the effect of economic and social conditions in agriculture on the economic welfare of the society or nation. *Vice versa* it also deals with the influence of economic conditions in the nation or society on the economic welfare of the agricultural community. The agricultural systems and returns from farming—financial or otherwise—are conditioned not only by causes arising within the industry itself, but by all kinds of external, social and economic causes. All laws and institutions which affect conditions in farming must, therefore, be taken into account in the consideration of farm management problems. Farming conditions also affect the social life of the nation and since we are all interested in the establishment of sound social conditions, we must study the relations between the farm and society. Farm management has, therefore, a social as well as a private aspect. It may be stated in brief that the whole object of studying social economics of agriculture is to synthesize the economic material toward some definite national end. With this object in view, all available material and economic facts must be brought together and examined in the light of present and prospective conditions. Such an analysis will give us an idea of the order and direction of agricultural production as well as of the extent of the efficiency in the utilization of national resources.

Rural social problems are extremely complex and before they can be studied in a discriminating manner, we must first analyze them to determine the parts that comprise them. Each of these parts will then require an intensive study possibly at the hands of specialists. Indeed no one science can deal with total reality of the rural conditions of working and living. A general and brief outline of the social economics of agriculture will include the following:

(1) Consumption economics.

(2) Geographical studies.

(3) Economic institutions and laws:

(i) Agricultural credit and rural indebtedness.

(ii) Land economics, including land settlement, development and utilization, land values, land tenures and tenancies, and public land policy with reference to taxation and security of land tenure.

(iii) Transportation and traffic: Traffic routes and rates and their influence on regional development.

(iv) National agricultural policy:

(a) Protection.

(b) Agricultural education.

(c) Development and propaganda.

A few more items, not less important, may be added to the list indicating the scope of the social economics of agriculture but the wide range of the study is obvious. Studies may be of the existing conditions or they may be historical tracing evolution, development and shifts. Historical studies are important in that they tell us how the present organizations have arisen and how changes have taken place. They may probably check the tendency of carrying thought far ahead of actual conditions.

For a large part of his data and information on most of the above subjects, the investigator has to depend on secondary sources like documents, State publications, census reports, departmental reports, gazetteers, trade reports, reports of commissions and committees and works of individuals. But these sources may not supply information in details enough for the practical solution of a particular problem or a specific situation and the teacher will then be required to collect firsthand data and information locally. Thus, for example, little detailed information on the economics of consumption is obtainable from any of these sources excepting of course the production and census reports which are found useful for a broad and general understanding of the consumption situation. There seem to be three possible methods by which the teacher may be able to secure additional or primary data and information and these are, (1) the survey method, (2) the case method, and (3) the accounting method. In order to get a more adequate perception of the conditions of farm life and farm work at a specific situation, it is obvious that we must, in some way, break up the social complex into some uniform or homogeneous parts before any one or more of these methods can be used. The methods of defining typical areas, representative cases and sampling require to be fully considered, but it may here be stated, in general, that any area is characterized by the number and composition of the population that occupies it, by the conditions under which they live and work and by the habits, customs and behaviour which they generally exhibit. The limitations of the accounting method are well-known and in the study of the social economics of agriculture, it has a limited application, being found useful in collecting data on a few projects like the standard of living studies under consumption economics. The case method aims at closely studying typical persons, groups, institutions, areas or situations and using the results obtained for understanding the whole complex. It is rather a method of intensive observation. The survey method is an extensive method and it is best adapted when the object is to observe on a large scale and attend to each individual case only to see whether it does or does not manifest certain common attributes. This method is by far the largest in use in conducting primary research in rural sociology, consumption economics and agricultural credit and indebtedness. The case and survey methods are not quite independent but rather complementary. One is synthetic, the other is analytic. Accounting has its use in both these methods.

CENTRAL DIRECTIVE ON FOOD SELF-SUFFICIENCY PLAN

IN pursuance of the Government's decision to stop all imports of foodgrains after 1951, the Central Ministry of Food has written to all provinces, States and Unions of States to intensify their procurement, so that after December 1951 all foodgrain deficits will be met from surpluses available within the country.

As a necessary consequence of the Government's plan of food self-sufficiency within the next two years, the production of food has to be increased to the maximum extent possible, schemes for which are being finalized by the Central Ministry of Agriculture with the cooperation of Provincial and States Agriculture Departments. It is equally necessary, however, for all areas in the country to collect the maximum quantities of foodgrains and make them available for the non-producing classes in rural and urban areas at a reasonable price. The Ministry of Food is, therefore, working out a basic plan of food distribution for the period 1950-52, stating the maximum quantities which the Central Government can give to the deficit areas during the next three years.—*Food Bulletin.*

DEVELOPMENT AND THE ECONOMICS OF MECHANIZATION OF AGRICULTURE IN INDIA

By D. T. BROWN

THERE is evidence which proves that the land for past thousands of years has been cultivated by primitive implements pulled by the ox or ass. The implements consisted of the simple wooden plough, hoes, and sickles. Later in the seventeenth century in England came the first signs of the development which was to follow, when the first primitive seed drill and a reaper were invented. The eighteenth century saw the gradual improvement in these and other forms of mechanization in agriculture until the advent of the internal combustion engine, when developmental advance became rapid. This culminated in the period covering the past thirty years when the increased usage of mechanical power and implements in agriculture has been phenomenal. In India mechanization of agriculture is only a recent development and is in evidence under certain specific heads, e.g. State operation of teams of tractors, acting as self-contained units, engaged in the reclamation of large areas of land, either virgin or weed-infested, by deep ploughing and subsequent mechanized cultivation. While admitting that this form of mechanization in agriculture is a degree of development, it must be said that it has been plucked ready made and planted in working order here. That it must also react on, and influence to some extent, general future development is definite but at the same time it is a phase rather outside the scope of this article which deals with the application of power and machinery in varying degrees to all the operations carried out under prevailing farming conditions.

Slow progress in mechanization in India

It is not perhaps true to say that no progress has been made in India. Some small advances have been made and interest generally in mechanization is increasing in the most encouraging way. At the same time it must be admitted that in most parts of Asia and Africa nearly all cultivators continue to rely on and operate implements and use methods handed down to them from past generations. This is due to circumstances and conditions over which they have no control—e.g. small and widely dispersed holdings, extreme poverty of the cultivator himself and, in some locations, the cheapness of labour. These factors all tend under existing conditions to restrict any rapid advance and make exceedingly difficult the adoption of any form of mechanization, which, even in its simplest form may call for some increased immediate capital outlay, and the laying aside of an implement or method used or practised since times immemorial. On the other hand, however, in Western countries factors such as limited labour and its high cost, large areas of both undeveloped and developed land suitable for mechanized cultivations, readily available capital and high standard of efficiency, have all automatically resulted in rapid development of mechanization in the field of agriculture.

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Pace of agricultural mechanization in Russia

In Russia, a country of which the writer has personal knowledge, development of mechanization in agriculture has taken place at an exceedingly rapid rate due in the main to extensive systematic planning, and under circumstances, where the State decreed, 'Irrespective of cost, hardships, hows or whys, this will be accomplished'. Russia with her incredibly large areas (some single farms now comprise an area of 400,000 atres) made mechanization an obvious answer and this together with a decision to abolish individual holding system and replace it by State-owned and State-controlled collective farms greatly assisted its speed of advance. Collective farms today comprise on an average a communal unit of 150 families cultivating a holding of approximately 1,500 acres. Some idea of the rapid development of mechanization in Russia can be formed from the fact that in 1928, 27,000 tractors were in operation and in 1936, during an interval of only eight years, this total rose to 380,000. Enormous difficulties were encountered during those years of rapid expansion when the availability of machines far outstripped that of skilled personnel for their operation and maintenance. Nation-wide intensive systems of theoretical and practical training finally overcame this handicap. This is a point of paramount importance and must never for a moment be lost sight of in the future development of mechanization in agriculture in this country for unless skilled and trained personnel are available in sufficient numbers for operation, maintenance and repair of machines and implements, mechanization cannot advance. It has sometimes been suggested that all that is wanted in India now art a few thousand tractors, small and large, to solve the problem of food. Even if 5,000 tractors b come available at once, I am certain that within a period of months not more than 10 per cent of these 5,000 would be in operation due to non-availability of trained personnel to operate and maintain them.

Lack of balance in mechanization development

At this point it may be of interest to consider a rather strange aspect of development in agricultural mechanization as it has actually taken place abroad. In the U.K. and the U.S.A. tractors in operation can be counted collectively by the million and have during the past twenty years been improved in design and operating efficiency, while cultivating implements have hardly changed at all and tractors continue the function of acting as a variable form of mechanical horse-pulling much the same equipment as before and at nearly similar speeds. In some farm operations mechanical development has resulted in the near complete elimination of hand labour. An example of this is the design and development of the combine harvester which cuts, threshes and bags cereal crops in one operation. In other farm operations, such as root crop harvesting, mechanical development has been slow and generally today such operations are carried out by manual means and in a manner similar to that of 100 years ago. In agriculture mechanization has not developed in the same way as say that of transport where development in all its branches has progressed and gone forward in unison. It is this aspect of mechanization development in agriculture, namely a lack of balance that Agricultural Engineering today are striving to adjust.

Mechanization means saving of labour

Let us revert for a moment to the elimination of labour in certain harvesting operations. Table I will give an idea of what development of mechanical harvesting methods means and its effects on labour productivity with the advent of the combine harvester.

TABLE I

Comparative efficiency of hand labour and mechanical cropping methods

Year	Production of 1 acre of wheat Method		Man hours required
1830	Sickle and Flail	...	57·7
1896	Binder and Stationary Thresher	...	8·8
1930-41	Combine Harvester	...	3·3

Mechanization of agriculture aims at the lowering of production costs by the saving of certain labour, increasing the efficiency and with it the output of that which remains. It enables the cultivator to carry out seasonal operation within specified times and to take advantage of exceptional favourable climatic conditions. An example of the increased efficiency brought about mainly by mechanization is shown in the fact that in the ten year period 1925-35, in England and Wales the manual output on farms increased by approximately 18 per cent and during this period the number of workers decreased by 14 per cent.

One of the features in the design and development of agricultural machines and implements is the necessity to keep their manufacturing costs as low as possible. A factor which may be called utilization availability is very low. A tractor, for example, perhaps used in more operations than any other implement or machine, will not be in use for more than, on an average, 1,500 hours in any one year. Ploughs may be in use for as much as 350 hours while most other machines will not have a working session of more than 100 hours. No matter how much grain a cultivator may grow and regardless of equipment, the whole operation of harvesting must be completed within a short period limited to weeks, and, for the rest of the year, certain harvesting machinery must remain idle. Thus a machine which can only be utilized for a small fraction of the year and the limit of whose economy or financial return is, apart from the work performed and the resultant benefits from such work, a reduction of labour costs during such short operating periods, must of necessity require the smallest possible capital outlay compatible with returns.

If we look at any farm implement and study it from an engineering view point, it will perhaps appear to be of crude construction and simple design and we may well say that for the foregoing reasons it must be so. We shall see plain bearings, simple open link chains, cast gears and very few machined parts. Cheapness does to a certain extent enforce such construction but the circumstances under which these machines have to operate have perhaps an equal bearing on such design and construction, and comes to the rescue of the designer in his battle against high production costs. Weight has to be kept as low as possible to minimize any increase of rolling resistance and the sinking of wheels into soft and muddy ground conditions, which if not desirable have so often to be negotiated. On this count notice how often timber is used in constructional features. Substitute a roller chain for the simple link and in no time it would be clogged either with dirt or chaff. Persevere with the roller chain and protect it by sealed covers and immediately expense and weight are increased. A statement made by an Agricultural Engineer that effectiveness is more important than efficiency is of considerable truth. With these limiting factors of cost, weight and simplicity of design and extreme working conditions of dust and mud, constants such as stresses and strains allowed for and overcome and continuity of effective operation achieved, the advance of design and development attained may well assume a new perspective. A well-known story is told of a very eminent engineer, who recovering from a nervous breakdown in a nursing home watched from his window with great satisfaction the working in the fields of corn nearby a reaper and binder. At a later date he took the opportunity of going to examine this machine in detail. When he saw how the machine was made and worked he had another nervous breakdown.

Prospects of mechanization in India

In India mechanization must without any doubt play a most important and paramount part in agriculture. Mechanical development does not at present mean the introduction of complex and high-priced machines or implements. Tractors, as I have already stated, have begun to play an important part, but only in certain specific fields. Its meaning is far deeper. It means the gradual improvement of present day implements and methods and the giving of increased efficiency and better performances and at the same time easing the lot of the cultivator and his bullocks. It means the introduction, after test, trial and modification, of small machines capable of performing operations better, quicker, easier, and more economically than by animal draught, and the introduction for usage on a collective basis in rural areas or village centres, larger implements and machines such as tractors and tractor ploughs, threshing machines, mowers, etc.

It is generally wrongly assumed that due to conditions prevailing in rural areas, mechanization can be of little interest or help to the small cultivator. Mechanization can mean the application of some proven mechanical principle in the form of a small modification or addition to the simplest of country implements, achieving in so doing, perhaps only a minute increase in efficiency or betterment of work performed. Taking into consideration the number of such implements used the cumulative resultant benefit must be great. This line of thought and action here in India is of far greater importance than thinking and acting in terms and applications far beyond both the financial and mental limits of the majority of cultivators. Consider again the benefits which must accrue if certain country implements could be either improved mechanically or replaced by new ones with better performance so that the work now performed by a pair of bullocks in a day could be increased by only 10 per cent. Not only would the number of bullocks to be maintained throughout the country be nearly proportionately decreased, but the land now used for the production of fodder crops for them be utilized for the production of foodgrains.

Conditions in India are entirely different from those that prevail in countries where development and utilization of mechanical aids has been rapid and has brought in its train great achievements in the form of high food production levels. These conditions cannot even be compared and some cannot even be changed in an effort to facilitate mechanization, for example, lack of rainfall in certain areas or seasons necessitates the fragmentation of plots to such sizes as can be easily irrigated and the cutting of bunds and channels in profusion, rendering the operation of mechanical implements, both tedious and often fraught with disastrous results. Mechanization must and will be a slow process. It must start in a small way and gradually grow. To attempt anything on a large scale at this juncture would be doomed to failure and the repercussions would be serious. Here the start must be small, carefully planned and allowed to develop on right lines.

Agricultural mechanization in any country largely depends on two things—the predominant type of farming and the extent of its standardization and the number of different manufacturers of agricultural machinery coupled with the size of their market. Standardize on what the country's farming is based, i.e. the crops for silage and grain and those for concentrated protein. Concentrate on simple cropping and standardize row widths. Have machines which will deal with both cultivations, have few manufacturers of agricultural machinery and let them concentrate on a few standard agricultural machineries with a huge potential market. Mass production at low costs will then result. In addition agricultural machinery development and research must establish a very close link with the farmer and the manufacturer. Action on these lines will, I am certain, contribute in the right way greatly to the development of mechanization which is essential if a higher level of food production in this country is to be achieved.

Economics of mechanization

Little yet can be established as fact relative to the economics of mechanization in this country. Economics of the type in question have far-reaching implications and involve long periods of time before a definite result can be established. While considering the economics individually in the usage of different items of farm machinery, it is most important to consider the effects of the use of such machinery on the total running costs of the farm. Let me cite two simple examples. A small tractor is purchased and in its first year has ploughed so many acres, carried out various other operations totalling a further number of acres, and, by taking into account interest on capital cost, fuel and oil used, depreciation, operator's wages and repairs and maintenance, an overall working cost of so much per acre is arrived at. It is possible then to compare for a specific season or period this cost with that calculated for work carried out by bullock power and country implements. This is however, not an easy task since it is difficult to separate the cost of bullock maintenance from the total cost. To all intents and purposes the tractor will probably appear to be the most economic proposition due in the main to its low running costs and the speed at which its work is accomplished, and, to the fact that it requires no food and little attention during the idle periods. In the second season the tractor economics still look good, but not so good as in the first season due perhaps to increased repairs and maintenance costs as tractor ages ; and then in the third season for some reason or other the tractor is put right out of commission and the previous season's enhanced profits, due to decreased operating costs, have become overnight losses. Tractors and other mechanical implements are allotted various working lives, i.e. a tractor in England is presumed to have a life of 10,000 working hours, during which time its capital cost is written off gradually in the form of depreciation. Not until this working life is finished and capital cost completely written off can the economics of the usage of such a machine be to a certain extent defined. I say to a certain extent for there are other illusive factors which are sometimes difficult to determine and sometimes are even lost sight of altogether; for example, the effect of the use of the implement and power on crop yields and quality, both immediate and future, must be considered.

Comprehensive economics of mechanization of agriculture, when taken to fine limits, are not easy to determine. On broader lines by the use of certain mechanical appliances certain labour is automatically eliminated and broad statements and facts are easy. One of the difficulties in comparative economics is that a hard and fast rule as to items of expenditure to be included when arriving at working costs per hour of a tractor has not yet been made standard. In some cases only actual time spent by a driver while driving is debited to the cost, in others his total wages, irrespective of whether he is operating the tractor or not, are included. There are various ways too of allocating depreciation.

Let us for a moment forget these rather complex facts and study some straight forward established figures. Let us take first some simple statements of facts concerning ploughing by bullocks and by tractors. At the present time the feeding and maintenance cost of a pair of bullocks do not fall on an average below Rs. 3 per day, in many instances it is higher. In addition to this there is the cost of the ploughmen; at least Rs. 2 per day must be allowed under this head, irrespective whether he is employed or is himself the cultivator. Thus we have a total of Rs. 5 per day for the bullocks and the operator. Now, after many series of experimental trials and results generally, it has been proved that the average ploughing rate by bullocks does not exceed ·56 acre per eight-hour day. From this, in conjunction with the daily costs, we get the rather astonishing figure of Rs. 9 per acre for the cost of ploughing and that too without any small allowance which might be added for depreciation of bullocks and implement.

Now let us consider the case of the tractor. Tables (Nos. III and IV) show the results of a series of trials and experiments which have been carried out at the Indian Agricultural Research Institute, New Delhi, and give working costs and various operating rates per hour of wheeled and tracked types of tractor over considerable periods of time. Take now the case of the wheeled type, the general purpose tractor—a machine which has proved its utility and worth in the U.S.A. by the fact that 90 per cent of all tractors now sold there annually are of this type and which may well prove ideal for operation in this country as it is simple in construction and operation and repairs can be easily effected locally. It can also by virtue of its design operate in comparatively small plots. Its running cost is Rs. 2·5 per hour and with a ploughing rate of ·64 acre per hour the ploughing costs give a figure of Rs. 3·9 per acre.

In Table II a comparison has been made between the costs of ploughing by tractors and bullocks. Apart from actual costs an important factor to bear in mind in the case of the tractor is that in one day it can plough nearly 10 times the area that a single pair of bullocks are able to, and the actual work done is of better and more even quality. Also to forestall a possible objection it can be stated that there is no job, except that of dung production, which this type of general purpose tractor cannot do in a better way and certainly more quickly than the best of bullocks.

To many who read this part an obvious retort will be, 'Those are fine figures, but where do *I* find the thousands of rupees required for initial capital outlay'. These are figures which show the economics of certain aspects of mechanization and are given mainly to prove how essential that its advance and development becomes a reality. As it even in a simple form begins to advance its benefits must become apparent and grow making it possible for improved implements and machines to come within the range of more and more cultivators. As in other countries, with the assistance of advances, repaid from increased yields and returns, collective and cooperative efforts, the present lack of capital in any shape or form will not be the bar to mechanization of agriculture in this country. On the other hand one might counter with following reply. It is estimated that a single pair of bullocks can maintain approximately 8 to 10 acres. Now a tractor of the type in question can maintain nearly 100 acres. This, in bullock power is represented by ten pairs. The average cost today of a pair, worthy of the name of bullocks is at least Rs. 1,000 and ten pairs may cost Rs. 10,000 or a suitable tractor and implements.

The advance, establishment and results in U. K. and the U. S. A. of mechanization in agriculture are ample proof that it is both a practical and economic proposition there. With modifications both in design and tempo to suit our cultivators, fostered and given every encouragement, one of our main national problems, the effective feeding of the now underfed masses, will be initially simplified and later finally solved.

TABLE II

Costs of ploughing by tractors and bullocks

Operation	Ploughing per hour (acres)	Ploughing rate per day (acres)	Cost per day	Cost per acre
Bullock	·07	·56	Rs. 5	Rs. 9·0
Tractor	·64	5·12	Rs. 20	Rs. 3·9

TABLE III

Tractor (cultivator owner) operating costs

Compiled from actual farm operations at Indian Agricultural Research Institute, New Delhi, and I.A.R.I. Sub-station, Karnal from 5-11-1946 to 20-5-1948 (1st Period) and from 21-5-1948 to 30-11-1948 (2nd Period), unless otherwise stated.

	D-4 (No. 1) Caterpillar Tractor (35 DBHP)		D-4 (No. 2) Caterpillar Tractor (35 DBHP)		Oliver '60' Row Crop Tractor (16 DBHP)		Farmall Row Crop Tractor purchased in 1934		Fordson Major Tractor (Wheeled)		W.D. 40 McCormick Deering (Wheeled) (32 DBHP)		International T.D. 14 Tracked (51 DBHP)
Purchase price Rs.	10,000 (in 1946)		10,000 (in 1946)		4,500 (in 1947)		Capital cost written off		8,000 (in 1948)		7,152 (in 1936)		8,000 (in 1937)
Period	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st†	2nd	1st & 2nd§
Total usage (Hrs.) :—	1474	696	1607	743	105	105	774	256	..	507	7156	809	3946
1. Labour ..	790	505	863	375	390	78	472	162	..	449	4507	420	1800
2. Fuel H.S.D. oil ..	1856	905	1728	996	..	..	..	..	..	..	7638	1095	5950
3. Fuel petrol ..	80	25	91	62	160	13	106	32	..	52	506	41	234
4. Fuel kerosine oil ..	23	22	22	2	646	114	1121	418	..	931	484	49	39
5. Lubricating oils ..	496	346	465	402	139	11	30	36	..	67	2633	182	1766
6. Repair and servicing ..	423	221	436	206	101	25	1730	63	..	164	8176	178	4757
7. Depreciation‡ ..	1854	8701	910	929	400	59	..	..	..	507	6398	724	3946
8. Total Rs. ..	5522	2894	5515	2972	1836	300	3559	711	..	2170	30342	2698	18492
9. Cost per hour Rs. ..	3·7	4·15	3·4	4·00	2·5	2·8	4·6*	2·77	..	4·28	4·24*	3·34	4·68

Notes :— Labour cost is based on present hourly cost of skilled tractor driver and mate and is calculated on operating time only; it being assumed that for other periods he is employed on other work to which his time can be charged.

‡Depreciation is calculated on the basis of an anticipated working life of 8,000 hours.

Hourly costs marked* are high on account of heavy charges on spare parts required for repairs and replacements. The corresponding figures in the second period show an appreciable reduction.

Interest on capital cost has not been charged it being assumed that money invested in tractors will produce a return at least equal to the rate of interest obtainable if the money had been invested in say stocks and shares. No charges on overheads have been included—figures being representative of those as would be incurred by a cultivator owner.

N.B. †From 1936 to 1944, at which date tractor went out of commission due to absence of spare parts up to middle of 1948.

§From 1-7-1945 to 30-11-1948, inclusive.

TABLE IV—A

Tractor operating costs (excluding charges on implements) and rates

Compiled from actual farm operations at I.A.R.I , New Delhi and its Sub-station at Karnal from 5-11-46 to 20-5-48 (1st Period) and from 21-5-48 to 30-11-48 (2nd Period), unless stated otherwise

	Oliver '60' Row Crop Tractor								Formall Row Crop Tractor							
	Hours		Acres		Acres per hour		Cost per acre		Hours		Acres		Acres per hour		Cost per acre	
Period	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
OPERATION																
1. Discing ..	21·5	..	22·5	..	1·05	..	2·38	..	41·5	61·0	54·9	70·25	1·32	1·15	3·48	2·40
2. Grubbing ..	173·5	72·5	284·0	97·47	1·64	1·35	1·52	2·08	12·4	14·5	15·5	17·50	1·25	1·21	3·68	2·29
3. Ploughing ..	25.0	..	16·0	..	·64	..	3·90	..	..	..	..	..	..	..	..	..
4. Reaping ..	174·9	20·5	189·6	16·25	1·08*	·79*	2·31	3·53	..	..	..	..	..	..	..	..
5. Drilling ..	41·5	..	31·6	..	·76	..	3·29	..	17·0	..	14·2	..	·84	..	5.50	..
6. Road work and idle running	85·6	11·0	..	..	..	..	..	..	17·5	7·0	..	..	..	..	..	..
7. Stationary work (threshing, etc.) ..	191·0	1·0	..	..	..	..	2·50†	2·80†	686·0	173·25	..	..	..	..	4·60†	2·77†

*Low due to small sizes of plots and shortage of labour to clear out crops quickly.

†Cost per hour.

TABLE IV—B

Tractor operating costs (excluding charges on implements) and rates

Compiled from actual farm operations at I.A.R.I , New Delhi and its Sub-station at Karnal from 5-11-46 to 20-5-48 (1st Period) and from 21-5-48 to 30-11-48 (2nd Period), unless stated otherwise

	I-4 (No. 1) Caterpillar Tractor								D-4 (No. 2) Caterpillar Tractor							
	Hours		Acres		Acres per hour		Cost per acre		Hours		Acres		Acres per hour		Cost per acre	
Period	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
OPERATION																
1. Discing	662·0	462·25	1192·00	857·88	1·80	1·86	2·06	2.25	823·50	510·75	1545·7	890·72	1·87	1·74	1·81	2·29
2. Grubbing ..	321·5	..	568·37	..	1·76	..	2·10	..	207·50	86·50	293·47	193·75	1·41	2·24	2·41	1·78
3. Ploughing	81·0	143·00	55·68	103·65	·69	·73	5·36	5·74	282·50	..	200·5	..	·71	..	4·80	..
4. Reaping ..	110·0	..	87·00	..	·79*	..	4·68	..	50·00	..	48·0	..	·96	..	3·53	..
5. Drilling ..	..	..	..	..	..	..	..	..	..	17·25	..	53·25	..	3·08§	..	1·29
6. Road work and idle running	298·8	79.75	..	..	..	..	..	..	239·00	126·75	..	..	..	..	..	..
7. Stationary work	..	6.50	...	..	..	..	..	4·15†	..	..	..	..	..	..	..	..

*Low due to small sizes of plots and shortage of labour to clear out crops quickly.

§Due to introduction of a new high capacity seed drill.

†Cost per hour.

TABLE IV—C

Tractor operating costs (excluding charges on implements) and rates

Compiled from actual farm operations at I.A.R.I., New Delhi and its Sub-station at Karnal from 5-11-46 to 20-5-48 (1st Period) and from 21-5-48 to 30-11-48 (2nd Period), unless stated otherwise

	Fordson Major wheeled tractor				McCormick Deering W.D. 40-wheeled tractor								International T.D. 14-tracked tractor			
	Hours	Acres	Acres per hour	Cost per acre	Hours		Acres		Acres per hour		Cost per acre		Hours	Acres	Acres per hour	Cost per acre
Period	2nd only	2nd only	2nd only	2nd only	1st†	2nd	1st†	2nd	1st†	2nd	1st†	2nd	1st & 2nd§	1st & 2nd§	1st & 2nd§	1st & 2nd§
OPERATION																
1. Discing ..	114·25	156·77	1·37	3·12	3463·14	465·20	8371·87	849·28	2·41	1·82	1·76	1·83	2181·75	4781·94	2·19	2·13
2. Grubbing ..	168·25	220·22	1·30	3·27	1194·37	200·75	3801·09	367·21	3·18	1·83	1·33	1·82	930·50	2731·62	2·94	1·59
3. Ploughing ..	..	..	..	..	583·25	..	797·55	..	1·36	..	3·11	..	153·25	184·20	1·20	3·90
4. Reaping ..	..	..	..	..	16·50	4·00	26·00	8·00	1·62	2·00	2·61	1·67	..	..	..	..
5. Drilling ..	..	..	..	..	45·50	2·50	92·40	9·50	2·03	3·80*	2·08	·88	25·00	69·00	2·76*	1·69
6. Road work and idle running ..	33·50	..	..	..	894·50	110·25	..	..	..	..	..	..	459·85	..	..	..
7. Stationary work	187·00	..	..	4·28‡	922·40	10·00	..	..	..	..	4·24‡	3·34‡	186·50	..	..	4·68‡

N.B. †From 1936 to 1944, at which date tractor went out of commission due to absence of spare parts up to middle of 1948.
§From 1-7-45 to 30-11-48 inclusive.
*Due to introduction of a new high capacity seed drill.
‡Cost per hour.

IMPROVEMENT OF FODDER GRASSES IN ARID AREAS

By R. C. KAUSHIK

IMPROVEMENT of fodder grasses is a very comprehensive matter with an extremely wide scope. Improvement can be broadly defined as development of quality and yield characters of suitable species of grasses by selection and breeding, study of detrimental factors which inhibit growth under different circumstances and evolving suitable methods of cultivation for varying broad types of climates and soils. Improvement of fodder grasses in arid areas should also cover all the aspects of this problem because, as a matter of fact, it is the study of complete problem with reference to a particular set of climatic factors, which are confined to definite tracts of this country.

Scope

A thoroughly scientific approach to this matter is essential. It is true that research to select and breed suitable species of drought-resistant natural grasses, which will not only yield heavily but will also possess all the qualities of a good fodder, is yet to be started, but even in the absence of this highly technical aspect of improvement, miraculous results are possible if nature is allowed to wield its powerful influence by adopting suitable methods of waste land management. If nature is allowed a full play in a grass land, automatically the yield goes on improving season after season and better types of grasses replace the inferior types. This change for the better goes on till a stable stage is reached. It is after such a stage only that the results of research in selection and breeding can be put to practical tests and comparisons. Suitable methods of cultivation are helpful in bringing the stable stage earlier. Improved methods of cultivation can further add to the yield and far better results than the natural stable stage are obtained. In short, elimination of adverse factors combined with artificial methods of cultivation can bring about a tremendous improvement over the existing state. Unless all harmful practices pertaining to waste lands are given up improvement of fodder grasses from this source is not possible.

Present condition

The waste lands in arid areas are used as grazing grounds for village cattle; these lands are mostly village common lands. The *Shamlats*, as they are called locally, were once adequately wooded and the number of cattle which grazed on them was also far less. The ideal conditions of light and shade, low soil temperature and high moisture contents of soil under the shade of trees enabled the land to stand the low incidence of grazing and some grasses and herbs did persist even though grazing continued throughout the year. These conditions continued to deteriorate with the increase in population; tree growth decreased constantly because grazing incidence also increased and generation could not get a chance to come up. The present state of the *Shamlats* is that very scattered remnants of mature trees and some bushes form the permanent vegetation; the grazing grasses grow during rainy season but are constantly grazed, trampled and uprooted by the village cattle. Only few plants sheltered by bushes get a chance to seed, which helps to reduce the rate of decreasing grass density. Trampling of wet soil by cattle hoofs reduces its porosity and absorptive capacity by compacting it; heavier soils get completely puddled. Compacted soil not only absorbs far less quantity of rain water, which is the only source of moisture, but also loses much larger quantity of moisture through surface evaporation. Most of the rain water is lost as run-off water. Want of adequate tree growth is also responsible for a poor absorption and high surface evaporation for various reasons. Dry winds blow during the summer and winter; the wind velocity is greater for want of breaks and consequently the rate of surface evaporation is accelerated for want of tree growth. In short, water conservation is at its worst, the soil is unprotected, grazing incidence is

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heavy and the soil gets no rest. Under these circumstances the grasses get little chance to develop to full size and to seed ; the factors which reduce the density of grass growth are constantly at work ; tender but better grasses which can otherwise grow have been ousted and the grasses dry up in a much shorter period than normal due to the poor soil moisture conditions. The net result is that net dry weight of fodder grass production per acre of waste land is far below the productive capacity of the soil.

Method of improvement

Soil moisture is the limiting factor for the development of fodder grasses in arid areas. The maximum natural yield can, therefore, be ensured if every drop of rain water is conserved and utilized and the grasses are given a free chance to grow, seed and regenerate. The stable natural stage in succession and density must be attained before a piece of land can be taken up for managing it as an ideal grass land for hay production or as a pasture or both. The artificial methods to conserve all available moisture and to aid succession by augmenting the seed supply and by improving the soil texture will not only shorten the period required for improvement but will definitely result in an improvement over and above the natural stable stage even. All this has been tried in a practical form and miraculous results have been obtained in the arid areas of the Western Punjab in Attock and Jhelum Districts. The striking results which have followed the elimination of inhibiting factors from the badly denuded and eroded areas of comparatively high rainfall zone in the foothills bear a testimony to this simple mode of improvement. What should be done to attain the maximum production of dry weight of fodder grasses in the arid zone waste lands is indicated below :

Replacement of uncontrolled grazing : The present harmful practice of grazing by unlimited number of cattle all the year round must be replaced by a more suitable system of grazing to give rest to the soil and to permit a free natural succession of grasses for improving the density and increasing the proportion of better species. The new system should be such that it will not only meet the above given objects but will also introduce a gradual change in the harmful habits of people. A complete stoppage of grazing for three to five years combined with cutting of grasses after seed dispersal is the ideal way for attaining the best results from protection. In any case, the whole area of a waste land cannot be taken up for complete closure because it definitely is a very drastic measure which is bound to be severely opposed by the villagers who are accustomed to uncontrolled grazing. At the most 25 to 30 per cent of a waste land can be taken up for this treatment, which means that the rest of the land will experience a severer incidence of grazing for five years at least. This definitely is harmful, particularly if the *Shamlat* is of a medium or small size. In arid areas the grass growth develops during the rainy seasons only ; the maximum harm by grazing is also done during the same season. Consequently a rotational system which will meet the demands of people for closure of a minimum area and at the same time will provide varying degrees of protection to all parts during suitable seasons is the most suitable system for replacing the present uncontrolled grazing. The preparation of rotational grazing schemes is a technical job. Entirely different types of schemes have to be devised for varying sizes of *Shamlats* ; the current incidence of grazing, conditions of soil and tree growth, etc. have to be fully considered before a really useful rotational scheme can be laid down. The sum and substance is that grazing must be stopped over a reasonable part of the total area continuously for enough time, particularly during the rainy seasons, to register the desired improvement ; at the same time, the rest of the area should be so managed that it not only does not deteriorate but is improved if permitted by the circumstances.

Water conservation measures : The object is to conserve and distribute rain water evenly over the whole area to provide adequate moisture for the grass growth on every bit of land. This has been achieved by digging interrupted contour trenches with continuous berms in the shape of contour bunds. Along a contour line ten feet long trenches 1 foot × 1 foot are dug leaving about two feet distance between the trenched ends. The earth from the trenches is used to consolidate a small continuous contour bund on the lower side of the trenches. The rows of trenches are spaced about 10 to 15 feet apart depending on the slope and the type of soil. The idea is that run-off water which is not absorbed, is entrapped all over the area as it falls. If the trenches get filled up, any extra water is held up by the bunds. To reduce the chances of breaches, the trenches are staggered in different rows. This method entraps all the rain water, which is also distributed evenly all over irrespective of the slope. Adoption of contour lines as the site for trenches and bunds also serve the purposes indicated above; it reduces the force of run-off water by even distribution all along; water moves along the bunds at right angles to the slope to spread out evenly. Thus all rain water, a large proportion of which would have been wasted as run-off water otherwise, is conserved; soil moisture conditions improve both in quantity and distribution with the result that the grasses get a better chance to improve in density, size and quality. This method can be adopted only if the grazing is completely stopped. In a rotational grazing scheme full advantage of the contour trenches cannot be obtained so much so that in a short period rotation it is not even worthwhile to dig them because they get obliterated during the very first rainy season after opening to grazing.

The losses by excessive surface evaporation must be reduced to the minimum to take full advantage of the trapped rain water. The presence of hedges, scattered shade trees and shelter belts of trees reduces the velocity of winds, lowers the air and soil temperatures and increases the humidity; all these help to reduce surface evaporation and thereby maintain a higher soil moisture content than in a treeless area. The planting of shelter belts of trees along the leeward side and on the contour trenches at suitable distances is, therefore, indispensable; the local species should be used rather than attempt to introduce new ones. It takes some time for the trees to grow up; to attain the same object meanwhile, hedges of evergreen shrubs should be planted along the contour bunds. All the scattered trees should be retained till the shelter belts are fully grown.

Soil working of any sort not only improves the absorptive capacity but also reduces the loss of moisture by surface evaporation. Consequently harrowing or hoeing with multi-toothed implements after the winter rains will be extremely useful. The maximum possible areas should be covered in a rotation every year.

The run-off water from the fields, villages and adjoining waste lands can be diverted into a closed area by constructing contour diversion bunds at suitable places. Shallow ponds and strong enough contour bunds at frequent intervals can be made to retain and evenly distribute this outside water supply.

Artificial methods to improve grass density: Broadcasting of seeds of the suitable species of grasses in the beginning of the rainy season is very helpful in improving the density of grasses. The best results are obtained if some sort of soil working has been done beforehand; hoeing or harrowing after the winter rains, and, if possible, soon after the first rain in June or so is extremely helpful. If multi-toothed implements are not available, drawing furrows along the contours with country plough, about two feet apart is also very useful, though it is not as quick and economical.

In Europe manuring of the grass lands to keep up the quality and yield of grasses is a common practice. The necessity is not felt till after a few years of continuous harvesting of the grasses. Occasional introduction of grazing after the harvesting of grasses is very helpful in this respect. Due to the protection given and also on account of the working of the soil shrubs like *beri* tend to spread; regular destruction of these pests is essential to keep up the quality of grass lands.

Future management

Once an area starts yielding to its fullest capacity, the maintenance becomes important. An area can be managed as a grass land, a pasture or both. A grass land for hay production is completely protected from grazing till the grass is harvested, after which grazing in a very controlled manner may be allowed to utilize the remaining uncut blades of grasses and to manure the area. In case of a pasture, grass is not harvested but cattle are permitted to graze in a rotation; a real pasture management in arid zone areas is not possible because the grasses do not persist for a major part of the year. After the rainy season, the waste lands can be utilized only as roaming grounds for the cattle because there is practically nothing for them to feed; this has to be done in such a manner that the rainy season growth of the grasses is not harmed indirectly by damage to the soil.

Consequently controlled grazing with a proper incidence to give adequate protection to soil according to seasons is the most important part of a proper management of the waste lands in arid areas. This can be administered by introducing a suitable rotational scheme. In addition, the water conservation measures and the operations to keep up the density and required admixture of species of grasses have to be continued regularly; these can also be fitted in the rotational scheme in such a manner that every portion gets the required treatment at suitable intervals.

Difficulties and solution

The village waste lands form the fields to be developed. A common property is nobody's property and this is very true of these waste lands. Mere advice on the above given lines is not enough; the ignorant, stubborn and suspicious villagers are to be brought together to form an elected managing committee under a *Panchayat* or in the shape of a cooperative society. They are to be taught that their common property is capable of producing much more if they can manage it in a particular manner as a joint body. It is a very difficult task and constant propaganda alone can achieve it. The method of improvement is not so difficult as putting it into practice. The magnitude of the problem is further increased when the extent of the waste lands and the practical difficulties are taken into consideration.

RICE SHORTAGE IN ASIA

MR. Norris Dodd, Director-General of the F.A.O., in a report to the F.A.O. Council said that the rice-consuming people of the Far East, with the exception of Siam, Burma and Indo-China, were generally worse off than ever before. Among the various measures which he suggested should be adopted in the Far East, Near East and Asia for increasing food production the following were emphasized :

(1) Careful cattle raising to ensure adequate bullock power for agricultural purposes as well as for milk production ; (2) large-scale campaign for vaccination against rinderpest ; (3) development of fisheries. Mr. Dodd said that in the East there were huge aquatic resources and there was almost an unlimited field for developing fish consumption ; (4) soil surveys and prevention of soil erosion ; (5) revision of land tenure conditions.

THE WOMEN'S PART IN THE FOOD PRODUCTION DRIVE

By F. L. BRAYNE

SIR John Boyd Orr has told us that the world must double its production of food in the next twenty-five years, or starve. This is a very terrible threat but we know it is true. Many millions of people in many countries are already underfed for part of the year and some of them are underfed all the year round.

Augmenting food supply by simple means

What is the prospect in India and Pakistan? Besides barrages, canals and hydro-electrics and the big things which Government alone can tackle, there are innumerable small things which the experts and scientists have worked out for us. They require very little capital but a great deal of hard work, enterprise, knowledge, cooperative effort and a lot of thrift and saving. What effect would the doing of all these small things have on the food supply? The late Sir Albert Howard of Indore compost fame, used to say that if people would only do the simple things recommended for the improvement of soil, water supply, cattle and crops the produce of the soil could be multiplied by three.

May I give a list of some of them?

1. The stopping of erosion by (a) stall-feeding livestock with food crops, ensilage and grass cut and carried from the pastures; (b) levelling and embanking all *barani* arable land.
2. Repairing, and if necessary putting bores into, and using for both harvests, all wells; better use of canal water, smaller *kiaris* (compartments), clean straight channels, etc.; and using all *jheels* and other monsoon water for irrigation.
3. Using the waste water from wells, houses and places of worship for growing vegetables.
4. Manure pits round the village; hay-boxes instead of burning cow-dung; composting all vegetable waste; green manuring.
5. Good seed, good ploughs, harrows and other tools.
6. Sowing seed in lines, ridging, roguing, weeding, etc.
7. Simple pest control—light-traps; washing seed; destruction of rats and parrots, etc.
8. Selective breeding of livestock.
9. Quarantining for ten days all new animals before allowing them to join the others.
10. Using the cooperative organization wherever possible.

The list could be greatly extended but is long enough to show what I mean. They are all terribly simple things but if they were all put into use everywhere they would change the face of the country. Not all of the crops would be food crops but there would be enough to satisfy Sir John Boyd Orr's demand for doubling the food supply.

No easy task

If it is all so simple what is the fuss about? Surely the people have only to be told about these things, to rush out and do them? Not a bit.

Wherever one goes the story is the same. The people won't take to these new things. They are quite happy as they are and will not do the extra work required, nor will they give up their pet extravagances—weddings, feasts, silver ornaments, litigation and so on—in order to save money to buy good seed, good ploughs, stud bulls, new tools, or whatever it is that is needed to improve their outturn. In fact their idea of a high standard is less work and occasional bursts of extravagance at weddings and so on, and when we suggest that they should work harder and

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save and scrape in order to grow more food and be better off they think we are attacking their standard of living instead of trying to raise it.

The problem

What is the answer to this conundrum? How are people to be persuaded to do these things? What incentive, what stimulus can be found to move them to action?

It has hitherto been rather assumed that all that is necessary is to tell people of the new and better ways of working and living and they will automatically adopt them. That may be so in countries with a generally high standard of living which everyone is ambitious to achieve or to maintain, but it is far from being so among people whose standard is low and where malnutrition is common. In fact the very opposite is the case. To produce more food, to improve health and to raise the standard of living requires very hard work, much saving and scraping, much self-denial and a complete break with old custom and traditions. To do all this requires high morale and an extremely powerful incentive. Where is the incentive among people who are poor and under-nourished, sunk in debt, and riddled with malaria, hookworm and other diseases that come from dirt, squalor and malnutrition?

Debt is no incentive. Debt bothers no one; it is normal and natural. Besides, the debtor fears that the only person who will benefit by his extra work will be the creditor. Hunger and ill-health are no stimulants to harder work. They produce the very apathy we are fighting.

Solving the problem

What then is the answer? Treated as an economic problem there is no answer. If we wish to escape starvation we must tackle the conservatism and apathy of the people not as an economic but as a social problem. The only hope of producing an incentive that will beat the desire for less work and occasional extravagance and will overcome the placidity of malnutrition and ill-health is to design a new way of life that is better than the debt and poverty, with their occasional feasts, and the ever-recurring hunger, dirt, discomfort, ill-health and squalor which his present way of life involves.

Having painted a picture of the new life—all can join in the task—we must not only convince ourselves but we must convince the peasant, that it is better than his present way of living. Such a picture was painted for the sepoys of the Army during the last war. It was based on the work of Government Departments and of many pioneers, official and non-official, and was used for the pre-release training of the sepoys. It is described in many Army pamphlets.

The role of women

I said that we must convince the peasant that a better life is possible. That is not quite accurate. The standard of living is the standard of the home and the standard of the home is the standard of the housewife, the 'gharwali' who keeps it. It is she who must be enlisted in the campaign for better food and better living. All through nature, the strongest instinct of the female is the well-being of its family and that instinct must be developed and exploited. Once a mother is convinced that vaccination will save her child from small-pox, can you imagine her hiding her child from the vaccinator or going to the temple of the goddess of small-pox for charms? Once she knows what is good for her children she will insist on getting it.

Years ago at the National Institute of Agriculture in Rome, a Minister of the Belgian Government read a paper in which he proved that in a country of small farmers like Belgium, the women are responsible for more than two-thirds of village life. They run the home and bring up the children, they make and mend the clothes, they cook the food, they keep the family in good health and they make the home comfortable and happy. Everything that makes home worth living in is in the hands of housewife, and it is she who must provide the incentive we are looking for.

To become prime-movers, however, in raising the standard of living the women must have far more knowledge than they have now. Not only must they have suitable education but they must have proper domestic training. Both in the schools and colleges and in the Women's Institutes or the cooperative society (why not have Cooperative Women's

Institutes ?) they must be taught everything there is to know about running a house and making it nice, cooking a balanced diet, keeping a family in good health and good heart, making and mending clothes, and the hundred and one other things which every village housewife should know.

The men have big departments to teach them how to run farms and keep cattle. The women must also have big departments to teach them how to run homes and keep families.

Once the village women have this knowledge they will be forever striving to make their homes lovely, and they will compete with each other, not in the weight of their ear-rings but in the brightness of their homes and the happiness of their families.

The women will then encourage their good men to grow the best crops or to carry on their craft in the best way possible. Why ? Because they want just one more thing, a sewing machine perhaps or mosquito nets, or whatever it is, to make home better. And each new thing will lead to another new thing. Our battle is won—the ambition for a higher standard of living has come upon the peasant and he will work hard and willingly to achieve his ambition.

The good wife will ask for the right vegetables, fruit and crops for the needs of the family, she will keep her good man in health. She will store the grain he brings where damp, rats, mice and weevils will not waste it, she will prepare the food so as to get its full value and waste nothing.

Best of all, the home will be a progressive force. At present it is the citadel of ignorance, superstition and conservatism. When a man is advised to change an uneconomic or unhygienic custom he now says his wife wont' let him. Once the wife is educated and trained he will no longer be able to say that. His wife will encourage him to try new things. 'I am trying a hay-box' she will say, 'and I have a new and better way of making the baby's clothes. You too must make experiments'.

All over the world it is difficult to persuade peasants to try new things. Where the women are uneducated and untrained it is more than difficult—it is impossible. The key therefore to the success of the food production drive is to design a better way of living and bring the vision of it, literally to every home in the land. The women, no less than the men,—and the girls no less than the boys, at school—must be so educated and trained that they will be convinced that it is so much better than their present manner of living and is so obviously possible to achieve, that they will gladly do all the work, the saving and scraping, the self-denial and the abandonment of bad customs and prejudices that are necessary to bring their vision to life in their homes.

TWO HIGH FODDER YIELDING TYPES OF LUCERNE

By RATTAN SINGH and H. C. MALIK

LUCERNE is an important leguminous fodder crop which is grown in the East Punjab. It is a perennial fodder crop which gives very high tonnage of highly nutritious green fodder in a number of cuttings in a year. It possesses a remarkable power of sustenance and is admirably suited to horses and working animals.

In order to explore the possibility of evolving a high yielding strain of lucerne, a replicated trial, extending over six years, with ten varieties of lucerne—five foreign and five acclimatized, numbered for brevity's sake, 4, 6, 7, 8 , 9, 11, 14, 15, 21 and 23—was conducted and concluded at the Fodder Research Station, Sirsa. Average yield of green fodder obtained from each of these is indicated in the following Table:

TABLE I

Total yield of green fodder per acre in maunds

Year	No. of cuttings taken during the year	Varieties									
		4	6	7	8	9	11	14	15	21	23
1937 ..	6	294	304	331	499	445	232	433	402	328	281
1938 ..	10	585	757	753	1108	1053	304	113	1006	869	445
1939 ..	8	782	1021	998	1135	1140	421	59	1180	1013	560
1940 ..	11	690	916	893	1040	1119	363	19	1091	870	491
1941 ..	11	30	729	768	889	913	201	8	897	725	473
1942 ..	9	270	423	496	627	656	111	2	589	473	138
Average yield per acre ..		521	692	707	883	888	282	107	861	713	398

It will be apparent from this Table that No. 9 gave the highest per acre yield of green fodder, viz. 888 md. while No. 8 with 883 md. was a close second. It will also be observed that under congenial environment conditions, one can get easily from these more than a thousand maunds of green fodder per acre in a year.

Similar trials, though ranging from one to three years only, were also carried out at the Hansi, Gurdaspur and Montgomery (now in Pakistan) Agricultural Stations. In these trials, too, No. 8 and 9 did exceedingly well and attained top-most rank.

Besides the yield, longevity or the capacity to give fodder for a comparatively longer period after sowing once, is a very desirable characteristic of a good variety of lucerne. In this respect too, No. 8 and 9 have exhibited marked superiority. It will be observed from the abovementioned Table that at the end of six years, they yielded 627 and 656 maunds respectively of green fodder in a year as compared to 111 maunds or even only 22 maunds per acre in some others during the same period. Incidentally it may also be remarked that at the end of six years these showed very much less tendency to become patchy, a phenomena generally brought about through death of plants due to high humidity and high temperature and, perhaps, due to rank growth of weeds.

On the basis of the above observations, therefore, types No. 8 and 9 are recommended for sowing if a highly nutritious and palatable fodder is desired.

Distinguishing characters of the types

Both these types are almost identical in most of the vegetative characters, namely, erect growth, vigorously growing plants,

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profuse tillering and extensive branching. They, however, differ in the size of leaves and colour of flower. In No. 8 leaves are broad and the colour of flower is distinctly violet. The leaves are mid-sized in No. 9 and the colour of flower is light violet. Both possess mature pods of light smoky colour and plump seeds, kidney-shaped and of light yellow colour.

Cultural methods

A few hints for the successful growing of these types of lucerne are given below:

Climate: Lucerne is well-adapted to semi-arid climatic conditions. It can withstand extremes of climate as is the case in East Punjab. High heat coupled with high humidity have an adverse effect on its growth.

Soil: It can be grown successfully on a variety of soils excepting, of course, those which are water-logged or are alkaline in nature. Well-drained alluvial soils are most suited.

Time of sowing: Lucerne is sown either in spring or autumn in the East Punjab. Usually autumn (November) sowing is preferred for the simple reason that good germination of seed is assured and that the young plants find healthy season for growth.

Seed and seeding: Seed germinates satisfactorily if sown in well-prepared soils at ½ in. depth. It is both economical and efficient if seeding is done with an ordinary hand drill in rows one foot to 1¼ ft. apart to facilitate interculture. Usually 3 to 5 seers of seed is enough to sow an acre.

After-care: This consists in keeping the crop free from weeds by running ordinary *desi* plough in between the rows after every cutting. Occasionally a dose of well-rotten farmyard manure applied after taking cutting followed by interculture and irrigation, greatly improves the crop both in quantity and quality. Generally irrigation is given after each cut but additional amount of water required to be given depends upon the prevailing season.

Time of cutting: The November-sown crop takes about three to four months to become ready for first cutting. The crop is generally cut when about 25 per cent to 30 per cent of the flowers have appeared. Subsequent cuttings are taken after every month or thereabout in summer and after 1 to 1½ month in winter. The crop does not make good growth during rainy season. Under favourable conditions 8 to 10 cuttings are obtained in a year.

Seed: Yield of seed is influenced by the prevailing season. At Sirsa, types No. 8 and 9, under favourable conditions, have given as much as 8 to 9 maunds of seed per acre. To get best seed yield, it is advisable not to cut the crop after February and restrict application of water in the seed setting stage. Seed ripens in May or June.

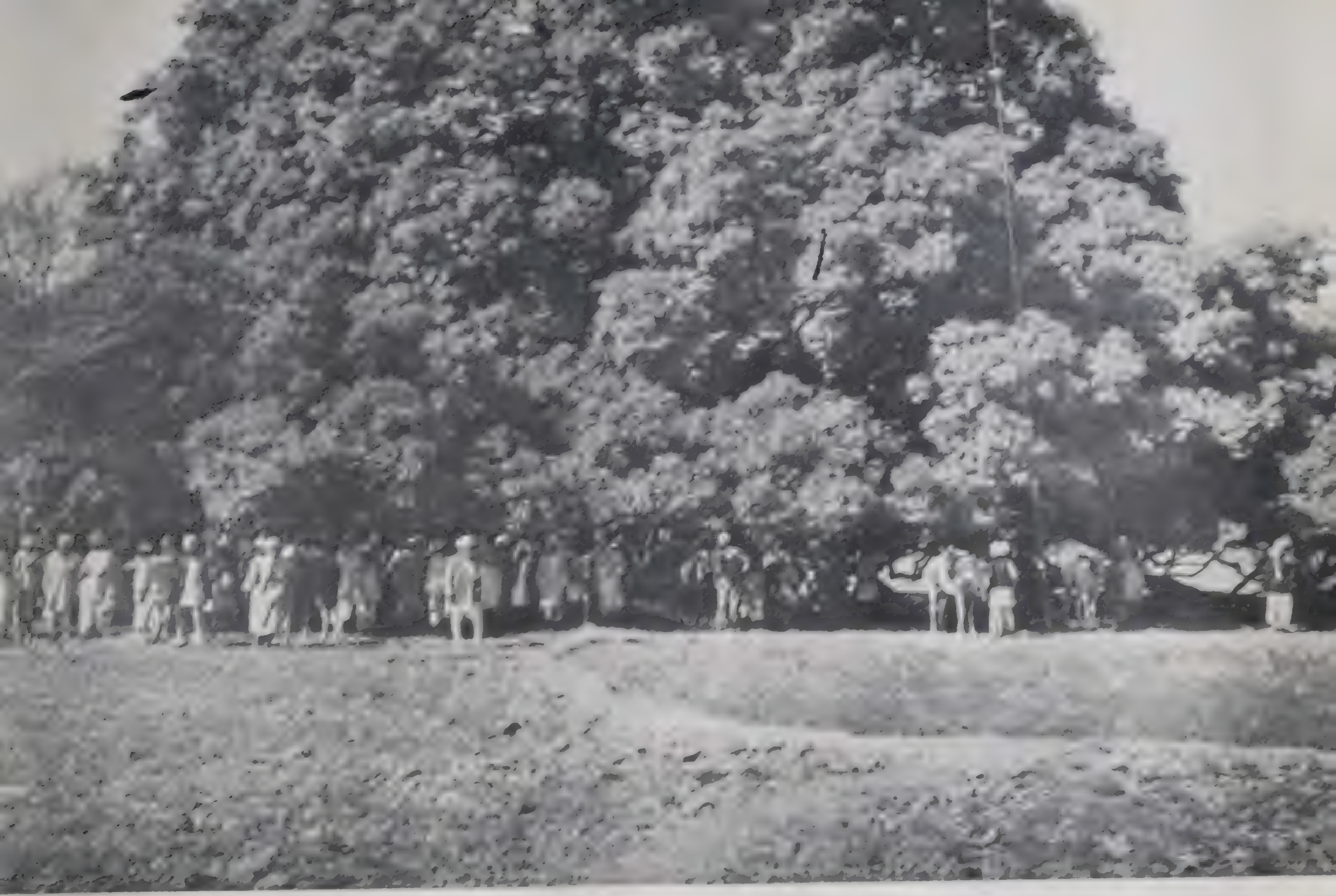
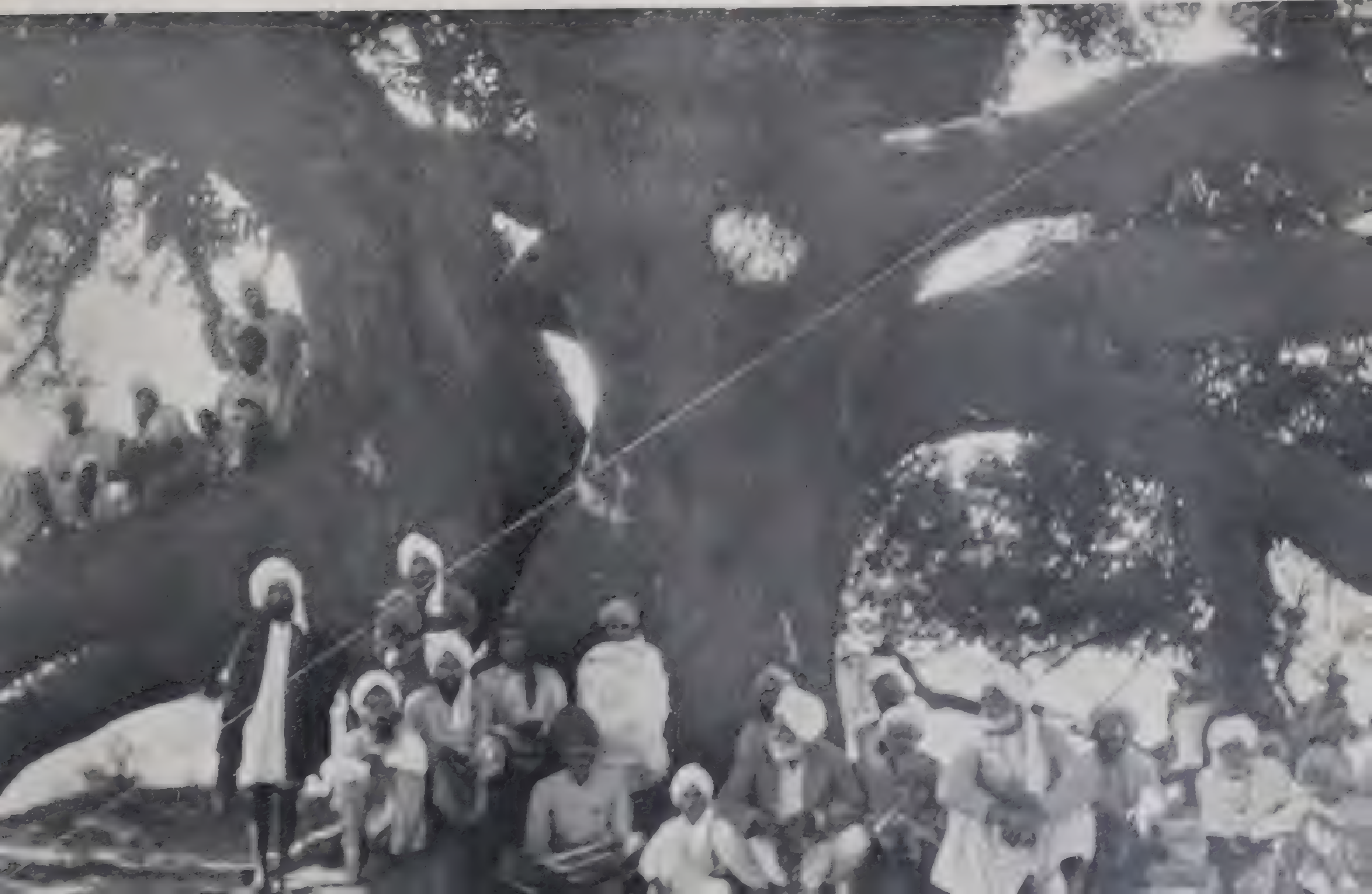


PLATE 31

FIG. 2 (above). Giant mango tree at Burail.

FIG. 3 (below). Stem of 'Chappar' mango tree.



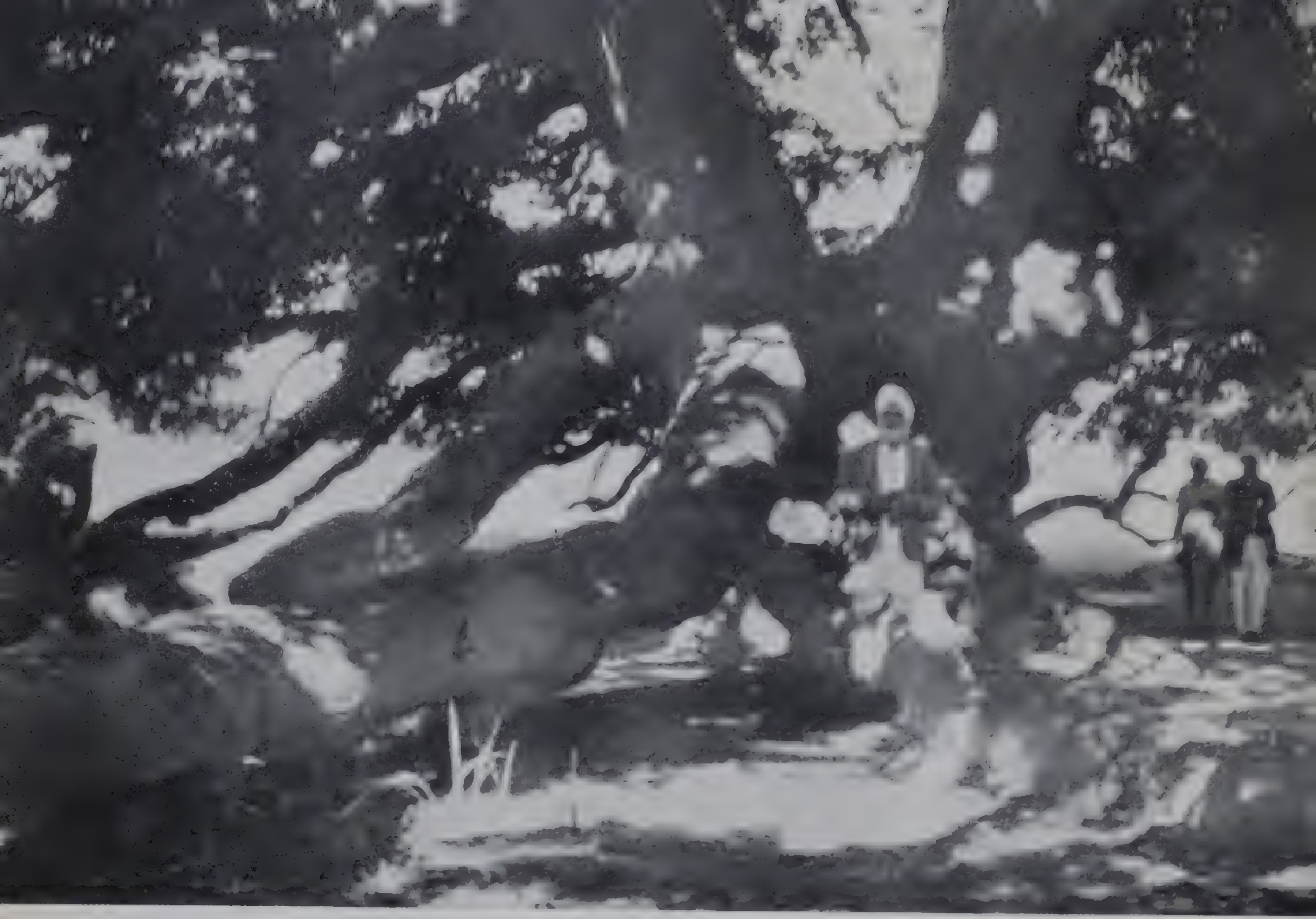


FIG. 4. One of the main branches of ' Chappar ' mango tree.

A GIANT MANGO TREE

By M. S. RANDHAWA

THERE is considerable agitation among cultivators of villages of Kharar Tahsil in Ambala District, where the proposed Capital of East Punjab is going to be built, against the acquisition of their land. This area is about four miles from Ambala-Kalka-Simla road on both sides of Ambala-Rupar road. I was approached by the villagers to inspect their village, and the precious land which they are going to lose. The soil is mixed loam and is exceedingly fertile, yielding two crops a year without the aid of artificial irrigation. The villagers showed me specimens of crops, such as sugarcane and wheat which were taller than normal. They also told me that near village Burail in this area there are a number of giant mango trees, the like of which cannot be seen elsewhere.

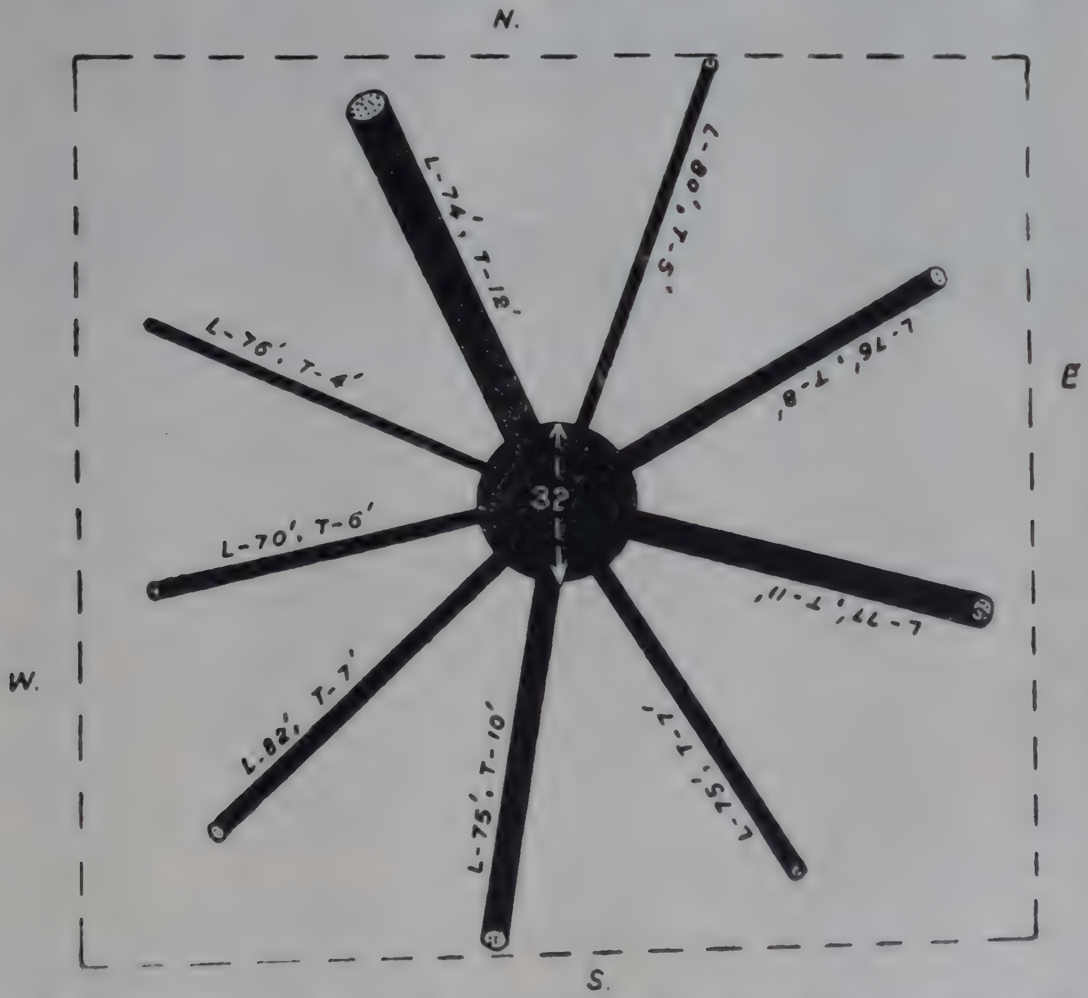


FIG. 1. Diagram showing the mango tree of village Burail, Tahsil Kharar, District Ambala, East Punjab.
L. indicates length of the branch.
T. indicates thickness of the branch.

Out of the trees shown to me, the biggest tree is named 'Chhappar' (Fig. 2). The circumference of its stem is 32 feet (Fig. 3). It has nine main branches trailing close to the soil, 5 to 12 feet in circumference, and 70 to 80 feet long. Each of these branches

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looks like a giant tree (Fig. 4). The total area occupied by the crown of the tree is 2,700 sq. yards. The average yield of the tree is reported to be 450 maunds. It is said that when 20 cart-loads of mangoes plucked from this tree reached Patiala, a few years ago, people asked whether a whole garden had been plucked. This tree is the biggest mango tree seen by the present author during his extensive travels in the Punjab and the United Provinces. I believe it is the biggest mango tree so far recorded and should be preserved as a national monument, even when the area is built upon.

EXPANSION OF COTTON CULTIVATION

THE distribution of better seeds, fertilizers, provision of irrigation facilities and introduction of a summer crop in suitable areas, are the main features of a Madras Government scheme to increase cotton cultivation as part of an All-India plan sponsored by Sardar Datar Singh of the Central Ministry of Agriculture.

A seed multiplication scheme commenced work in the Province in 1948. In the first year, an area of 908 acres was taken up and 3,100 bags of seeds were distributed. This crop is now reported to be vigorous and healthy. It is estimated that on an average a thousand pound yield of cotton per acre may be expected this year.

What the Scientists are doing

RANIKHET VACCINATION IN INDIA

RANIKHET disease is the most virulent poultry disease in the Indian Union because of its great infectivity, its rapid spread and the enormous losses for which it is responsible. The disease was first reported in this country in 1927 in a farm of imported English White Leghorn fowls in Ranikhet (U.P.). This was later identified to be the same as Newcastle disease found by Doyle. Subsequently outbreaks of this disease have been reported from almost all the countries.

This disease is characterized by sudden onset, rapid course and high mortality. It occurs during all the seasons throughout the country. All breeds of fowls are affected alike. Fowls of all ages and both the sexes are affected though in Madras it was observed that *desi* breed is comparatively resistant to this disease. Outbreaks seem to occur even in the very well-maintained flocks. Fowls, turkeys, and guinea-fowls are susceptible to the disease but pigeons are resistant. As is generally known the disease is caused by ultra-microscopic virus and appears in acute, sub-acute, and rarely in chronic forms. The incubation period varies from 4 to 11 days with an average of five days. Infection is caused by eating of droppings from mouth or the discharge which contaminate drinking water. Attendants are also liable to transmit the disease. Runs and houses occupied by fowls are believed to remain infective for one or two months.

In view of the serious losses to the poultry industry caused by this disease, extensive research was undertaken at the Indian Veterinary Research Institute, Izatnagar, and as a result of prolonged research and large-scale field experiments conducted at that Institute an effective chick-embryo vaccine has been evolved and now systematic vaccination of poultry in almost all the provinces and States has been adopted on a large scale. This vaccine has proved to be very efficient and has been in demand from several outside countries.

In India vaccination is generally performed on a large scale by the Assistant Disease Investigation Officers (Poultry) in the provinces of Madras, Bihar, Central Provinces, Berar, Assam, Bombay, Orissa, East Punjab, the United Provinces and the States of Hyderabad, Mysore, and Baroda. Vaccination is also done at the Indian Veterinary Research Institute. In all the provinces and States, except Madras and Mysore, vaccine is obtained from the Indian Veterinary Research Institute. In the latter case it is prepared locally. Proposal for starting centres for vaccine production in other provinces is also under consideration.

During the year 1946-47 over 2·6 lakhs of birds representing fowls, guinea-fowls, and turkeys, were vaccinated under different conditions in the rural and urban areas. The vaccination has been found to be generally safe and resulted in satisfactory immunity. In a small number of cases, however, reaction due to vaccination was observed and manifested itself in various forms. In some cases mild constitutional disturbances like inappetance, drowsiness and diarrhœa on the third or fourth day occurred, but passed off quickly. In cases of severe type there was 50 to 80 per cent fall in egg production in laying birds, continuing for three to four weeks, after which the birds became normal.

In some cases of severe type there occurred paralysis, either temporary or permanent. Two to six per cent developed temporary paralysis which passed off soon. Permanent paralysis occurred only in 0·5 to 1·5 per cent of vaccinated birds. Among other rare complications, temporary lameness and twitching of neck and resuscitation of coccidiosis was observed. A few birds laid soft shelled eggs. The rate of mortality due to vaccination has been observed to be very low. From the experiments performed it is known that this vaccination confers a reliable immunity; in two places birds were found to be immune up to 12 months after vaccination. (A.C.M.)

What's doing in All-India

INDIAN SUGAR INDUSTRY[*]

THE research work sponsored by the old Sugar Committee and the present Indian Central Sugarcane Committee has borne fruit and has helped appreciably in developing the sugarcane and sugar industries in India to their present standards. Both fundamental and applied research in agricultural and technological aspects of sugarcane and its products have indeed played very important role in developing this industry and to make India the largest sugarcane-growing country in the World. The rapid spread of the Coimbatore varieties of cane in nearly 85 per cent of the cane area in India and of their extension into many other countries like Australia, South Africa, etc. bears sufficient testimony to the importance and value of research and of its extension into the cultivators' fields. Important changes have been brought about in the sugarcane industry by the application of the results of research into it. The main changes brought about recently may be judged by the figures given below for the years 1931-32 and 1945-46:

	1931–32	1945–46
1. Area under sugarcane (Lakh acres) ...	29·72	38·47
2. Area under improved varieties (Lakh acres) ...	11·68	35·46
3. Percentage of area under improved varieties ...	39·30	83·10
4. Average yield of cane per acre (Tons) ...	14·10[**]	14·00[**]
5. Percentage of cane utilized for		
(a) manufacture of white sugar ...	6·50	25·00
(b) manufacture of *gur*	64·70	52·00
6. Total production of factory sugar (000 tons) ...	158	944[†]
7. Consumption of white sugar (000 tons) ...	982	1,045
8. Total imports (000 tons)	536	Nil
9. Average sugar recovery for		
(a) India as a whole (per cent) ...	8·89	10·09
(b) U.P. (per cent) ...	8·59	10·09
(c) Bihar (per cent) ...	9·06	10·49
10. Number of operating sugar mills ...	31	145

Although remarkable improvements in most of the items mentioned above have been secured, the average yield of cane per acre has unfortunately remained stationary between 14 to 15 tons in the last decade and a half. It is in the agriculture sphere where greater attention and more intensive research appears to be necessary.

Since its formation in November 1944 and up to the end of March 1948, the Indian Central Sugarcane Committee has incurred the undermentioned expenditure on investigations connected with the agricultural and developmental aspects of sugarcane and on the intricate problems of sugar technology and the training of necessary personnel for the latter:

	Rs.
For schemes of sugarcane research ...	9,78,510
For schemes of sugarcane development	4,36,841
For schemes of technological research	1,56,079
For maintenance of Indian Institute of Sugar Technology... ...	13,47,897

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[*] Address of Sardar Datar Singh, President of Indian Central Sugarcane Committee, at the Eleventh Meeting of the Indian Central Sugarcane Committee held at Walchandnagar on 12 February, 1949.

[**] The average acre yields of cane from 1925-26 to 1930-31 ranged between 11·6 to 12·3 tons. In 1931-32 it increased to 14·1 tons. The average yields from 1933-34 to 1941-42 ranged between 15·0 to 15·6 tons per acre, that of 1945-46 however fell to 14·0 tons per acre due to the abnormal season that year.

[†] The maximum production of 1,242,000 tons was secured in 1939-40.

We are proud of our achievements so far, but we are also fully conscious of the fact that we have still a great way to go, in order to reach our national goal of self-sufficiency in respect of sugar. Though India is the original home of the sugarcane, it was surprising that she has had to depend for the supply of almost the whole of its white sugar requirements on imports from Java and other countries until the industry was granted fiscal protection in 1931-32. This discriminating protection is still in operation and the Indian Tariff Board is now busy to examine whether this industry still needs these tariff walls.

At its last meeting, the Indian Central Sugarcane Committee had recommended the continuation of protection for at least one year more and the long-range policy that should be adopted in this connection has been discussed by your *Ad Hoc* Sub-Committee on 8 February, 1949 and its report is now in your hands for consideration. We are all alive to the fact that the present price of sugar is double the world price and that India will not be able to stand foreign competition, until it can reduce its sugar price and bring it down in parity with world prices. This will be possible only with larger production of sugar as well as of cane per acre. The chief remedy for stepping up cane production lies in providing good quality, disease and pest-resistant varieties of cane to the growers, to supply them enough manures and fertilizers as well as adequate quantities of irrigation water, so that he might meet the heavier demands of the improved canes in these respects. The latent qualities of the valuable cane material we have now produced can only be developed and brought into full play by intensive and not extensive methods of cane cultivation. If the programme framed by this Committee for its Five-year Development Schemes is carried out timely and properly by the various Provincial Governments who have undertaken to work out these schemes, it is hoped that significantly larger yields of cane and sugar per acre will accrue and the target of production of 16 lakh tons of sugar reached at the end of the next five years. If this objective can be achieved, it is also expected that larger and larger areas that are now under cane will be released for the cultivation of food and other essential crops that are in short supply now. If everything goes well it is anticipated that a time will come within the next decade when almost 50 per cent of the present cane area could be diverted to other essential crops, without affecting adversely the production and supply of sugar in this country. The concerted efforts of the agriculturists, the industrialists, the traders as well as the full cooperation of the consumers and the help and guidance of the scientists and the technologists will be needed to lead us to this goal. I am sure all concerned with the sugarcane industry will not hesitate to consider this national interest more important than their own personal interests.

In order to intensify cane research and with a view to provide more seed material and greater amount of scientific advice to the cultivators, this Committee had visualized that the area under sugarcane research stations should be enlarged at least to 200 acres each in which about 75 acres should be under sugarcane experiments every year. Certain Provincial Governments, however, have pointed out their limitations and difficulties in acquiring more land and to maintain large farms for this purpose. The position has, therefore, had to be re-examined by your *Ad Hoc* Advisory Sub-Committee, whose report is also in your hands for consideration today.

You will be sorry to hear that in spite of your considered recommendations to transfer the control of the Sugarcane Breeding Station, Coimbatore, into your hands, the Government of India have recently decided that it is not necessary to do so and that barring the transfer of control they desire that steps which may be necessary to step up progress at the Coimbatore Station should be taken both by the Indian Agricultural Research Institute and your Committee. This subject will again come up for your consideration.

Regarding the sending out of a mission to foreign countries to collect necessary data for framing the plans and estimates of the Lucknow Institute, the Government of India have desired that this question might be put up to them after the appointment of the permanent Director of the Indian Institute of Sugar Technology has been made. The Federal Public Service Commission has fixed 1st March for the selection.

The United Provinces Government have recently agreed to hand over the Bhadruk

Farm to the Committee with effect from 1 May 1949, with the exception of the Dairy buildings on the terms and conditions specified by the Committee.

The question of the future finances of this Committee was discussed in the last meeting and the Honourable Minister for Food and Agriculture assured us that it would be his endeavour to help the Committee to secure adequate finances for its developmental activities and to ensure a measure of financial stability, on which foundation, the Committee may be able to build up a plan for national self-sufficiency in sugar and allied foodstuffs. So far, however, the Government of India have not taken a decision regarding the basis on which their annual grants will be paid to us during the current and the next financial year. Such delays on the part of the Government of India cause great anxiety and uncertainty to the Committee.

I do not propose to recapitulate, at this stage, the points coming up for discussion today. They can be dealt with *seriatim* as they come up on the agenda. A statement of the actions taken on your decisions at the last meeting will be discussed at a later stage. The appointments of the various Standing Sub-Committees and of a Standing Fact Finding Committee and also of a small Development Committee will have to be considered. The election of a Vice-President for the financial year 1949-50 will also have to be made.

With the increase in the scope and activities of the Committee, the work in its headquarters office as well as at the Indian Institute of Sugar Technology has increased considerably. The satisfactory manner in which the Secretary and his staff at the headquarters and the Director and his staff at the Indian Institute of Sugar Technology at Kanpur have discharged their respective duties is commendable and deserves mention.

I thank you once again, Gentlemen, for your continuous help and cooperation and with your permission, I will now take up the agenda.

FIGHTING ON THE FOOD FRONT : CENTRAL PROVINCES

OVER 300 acres of weed-infested land are being reclaimed in the Central Provinces every day as a part of the Province's effort towards putting more land under cultivation for increasing food production. From April 1, 1949, an area of 10,934 acres has been reclaimed and during the week ending May 14, 1949. 2,205 acres were reclaimed which works out at an average of 315 acres per day. The Government of C.P. have hired 90 tractors from the Central Tractor Organization of the Government of India. These tractors are at present working in four batches, at Patharia and Khurai in Saugor District and Piparia and Dularia in Hosanabad District.

COCHIN

N. SANKARA MENON

RAINFALL during the south-west and north-east monsoons of 1948 was sufficient and well-distributed and there was very little damage to crops either due to floods or drought. There was no serious attack by any pest or disease except over a very small area in a portion of the Chittur Taluk and the season was favourable for all crops. The first crop of paddy gave very good yield and the second crop also is coming up well except in the small area mentioned above where the crop was destroyed. The Department rendered all help to the agriculturists to save the crop in the affected area.

Agricultural education

The Agricultural School in the Central Farm which was closed for some time was re-opened to train more hands who would, after completion of the course of one year, go to the villages and educate cultivators in up-to-date methods of scientific cultivation of the important crops in the State. A full-time teacher is appointed and the research staff also conduct classes in their particular subjects so that the students are in touch with all the activities in which the Department is now engaged. The present batch consists of twenty students and preference is given to candidates who have passed the School Final Examination. The training imparted is sufficient to qualify the candidates for appointment in the Department as Maistries, Fieldmen and Demonstrators.

'Grow more food' campaign

Groundnut cake was not available in sufficient quantities for the manuring of the second crop of paddy in time and the scarcity was so keenly felt that many who realized the advantages of applying this manure had to go without it. The price of the cake also has gone up very high and even with the subsidy of 25 per cent offered by the Government, many cultivators find it difficult to purchase the manure. So long as the price of manure remains at this high level, it is desirable to enhance the subsidy if tangible results are to be obtained in the drive for increased food production. The question of increasing the subsidy is receiving the consideration of the Government.

Production of compost

The only solution to meet the shortage of manure now experienced is to take up the manufacture of compost in all the Municipalities and *Panchayats* where night soil and organic refuse are available and to encourage cultivators to prepare this manure in their own farms by giving a subsidy based upon the quantity of manure prepared by them. The propaganda conducted by the officers of the Department has resulted in some success and the Cochin Government have under consideration a scheme for the preparation of compost in the State on as wide a scale as possible. Compost is now prepared under a few Municipalities and the other Municipalities and *Panchayats* which have not taken up the work will be persuaded to start the preparation at an early date. The advantages of using compost manure for paddy, pineapples and several other crops have been realized by cultivators and there is a steady demand for this manure. It is hoped that the production will be increased by at least four times during the next two years.

Green manure

The importance of green manure for several crops especially paddy is realized and there is great scarcity for this manure in places lying away from the forests. Daincha (*Sesbania aculeata*) is found to give good results where the first crop of paddy is transplanted and the use of this green manure is increasing in the State. In order to make it more popular, the Department intends to distribute the seeds on a large scale during the next season

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and steps are being taken to procure at least 16,000 lb. of the seed for distribution among cultivators.

Glircidia maculata (*Konna*) is found to thrive very well in the State and the plant can be periodically pruned to provide green manure for paddy. Arrangements have been made to produce and distribute at least 6,000 seedlings for planting when the rains start during the next monsoon. The distribution of more seedlings every year will be pushed on so that green manure can be had in sufficient quantities for increasing paddy production.

Trials have shown that *Sesbania speciosa* grows very well here and can be cultivated for green manure purposes. The seeds obtained in the Central Farm will be distributed among cultivators for growing the crop on the bunds of paddy fields which practice has been found to be very convenient. All efforts are therefore made to increase the production of food crops by providing large quantities of green manure.

Agricultural conference

A conference of teachers trained in agriculture, Officers of the Agricultural Department and several non-officials and cultivators interested in increasing food production was held at Trichur on 17 October 1948, the Hon'ble the Prime Minister, who is in charge of Agriculture, presiding. Several speakers spoke on the practical steps to be taken for increasing food production and great stress was laid on providing more water for irrigation and increasing the source of manure by manufacturing compost on a large scale. Much useful information was gathered during the discussions and the proposals put forward by the several speakers are under the consideration of the Government. Measures which will be taken as a result of the discussions are expected to increase the production of food crops to a great extent.

FIGHTING ON THE FOOD FRONT : MADRAS

THE utilization of Madras City sewage for food production purposes is at present under active consideration of the Government of Madras. A scheme whereby 4,400 acres of land will be irrigated producing about 6 md. of additional foodgrains per acre has been suggested to the Provincial Government by the Sewage Expert of the Central Ministry of Agriculture. The scheme proposes to utilize for the present 20 million gallons of city sewage in four areas which have been selected in consultation with the Provincial Government.—*Food Bulletin.*

BIHAR

J. S. PATEL

THERE was a severe second flood in the Ganges in September and in many places, *kharif* crop suffered due to heavy floods. In other places the crop suffered due to late start of the monsoon. The white sugar belt (Saran, Champaran and Muzaffarpur) recorded a severe gale of high intensity resulting in largescale lodging of sugarcane. Paddy suffered from the attack of case worm.

The following quantities of seed were distributed in Patna Range.

Wheat I.P. 52	...	497 md. 20 sr.
Gram ...	...	281 md. 22 sr.
Other *rabi* seeds	...	8 md. 2 sr.
Vegetable seeds	...	24 seers.

In Patna Range 186 wells and 27 *ahar* and *pynes* were constructed during the quarter ending November, 1948.

Largescale trials with Agroxone and Y.F. 1541 were laid out for controlling Striga. Chemical treatment with Methoxone (1 per cent dust at the rate of 28 lb. per acre) was found to be effective against this parasite. In this season Striga was more intensive than the preceding year in the district of Saran.

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A serious outbreak of white fly and Pyrilla was met with at Motihari (Champaran District) and Motipur (Muzaffarpur). Experiments were carried out to control the pest on a large scale on the different concentrations of chemicals recommended.

The performance of new improved varieties C.O. 453, B.O. 10 and B.O. 11 given out for general cultivation was reported satisfactory throughout the white sugar belt of Bihar. B.O. 24 has given an outstanding performance as a variety eminently suited for water-logged and flooded areas. In tonnage it is equal to C.O. 453 and in sugar 1·2 per cent higher.

Great differences in resistance to wilt are being found in the varieties under test. The infection has been found from 11 per cent to 55 per cent in different varieties.

Grading of *ghee*, tobacco and mango was continued, the quantities involved being 3,221 maunds, 5,000 maunds and 1,513 maunds respectively.

FIGHTING ON THE FOOD FRONT : BOMBAY

ABOUT 1,40,000 acres of waste and weed-infested land in the Province has been reclaimed with the help of tractors. There has been heavy demand from private owners for tractors and the Government have placed orders for 50 Czechoslovak tractors. During the next two or three years it is proposed to bring under cultivation three lakh acres of waste and weed-infested land thereby increasing the food production by about 65,000 tons.

Across the Borders

SUNLESS GARDENS ARE HERE*

By DYSON CARTER

AT last it is practical to grow plants without sunshine. One can do it at low cost, winter or summer as a hobby, in a corner of one's cellar, or on a large, commercial scale. For many years amateur and professional growers have tried to work out an economical way of raising plants independent of sun and rain, free from the vagaries of the weather. Thanks to scientists of the United States Department of Agriculture, working at the famous research centre in Glenn Dale, Maryland, an amazingly simple method solves the tough problems that have baffled experimenters up to now.

These artificial gardens have several exclusive features. Most striking of all is the lighting system used. Of course plants must get an abundance of radiant energy in order to grow. Artificial light has long been used to supplement daylight in greenhouses, in order to speed up growth. By using expensive 'sunshine lamps' of the mercury vapour type, scientists have been able to make plants thrive without any natural sunlight at all. The results were never very good. High cost of equipment, and heavy power consumption, made such lighting impractical.

First change made by the Glenn Dale scientists was fairly obvious. They tried high-voltage cold-cathode tubes—the modern fluorescent lamps. Such lamps give more light at less cost than any others readily available. But the question remained, would fluorescent lamps give the kind of light needed by growing plants ? From the many coloured tubes available, it was logical to try those giving the most 'blue' light, so the plants would get plenty of ultra-violet. But the true experimenter is not governed by logic alone. The men at Glenn Dale decided to try everything in the radiation spectrum. This led them to a surprising discovery.

When they used fluorescent lamps giving out light not at all like daylight, but ranging from orange to rose in colour, their test plants responded at once. Their first work was done with plant cuttings. Orange-red light made the cuttings take root quickly. They grew strong and healthy. Results were much better than with white-to-blue light. In fact the orange-red flourescent tubes made cuttings grow faster and better than they did in natural sunshine !

Clearly, this was important news. It led straight to another vital find. With their cuttings thriving, the experimenters began to lower the intensity of the light. They used fewer and fewer fluorescent tubes to illuminate a standard area of plants. To their astonishment they were able to get excellent growth of cuttings when the intensity of the light was cut below 100-foot candles. Judged by previous standards of artificial lighting this is a small quantity of radiation. Still it gave better than normal results. In fact normal growth was obtained in many cases with only 40-foot candles. And in one experiment, using a special helium-filled tube, the plants responded with just 10-foot candles of illumination.

We can disregard these very low figures. The key fact is this : even using much more than 100-foot candles of fluorescent light, the small cost of such radiation makes the system keenly interesting in a commercial sense.

To grow seedlings, more light is needed. Here the United States Department of Agriculture workers proved that both reddish and bluish light is unsatisfactory. Different plants have different needs. But in general the 'soft white' fluorescent tubes worked best for seedlings, sometimes combined with 'day-

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*Reproduced from *Science Digest*, April 1948.

light' and blue tubes. The necessary illumination runs around 600-foot candles. In these tests another unusual fact came to light. If seedlings are grown at the temperature that suits them best—that is, when they are kept quite cool—much less light is needed. If they get warm they require more light. This is all to the good, because the lower the heating and lighting required for best growth, the lower the cost.

What practical use can be made of these discoveries? Underground gardens have already been built and tested. They are little more than holes in the ground. For example, a 10 by 36-foot excavation is roofed and lined with material such as cinder blocks. Walls and floor should be insulated. But a very attractive feature of these underground gardens is their simple, cheap construction compared to conventional greenhouses. The striking fact about the new growing system is that no special heating system is needed, even in cold winters. The fluorescent lamps, although they are cool compared to incandescent bulbs, supply plenty of warmth to the plants. In sub-zero weather the Glenn Dale shed, with 360 square feet of floor area, was easily kept around 60 degrees with occasional use of a small, one-kilowatt electric heater. So there is no investment in heating plants, and the fuel cost is practically *nil*. Indeed, the temperature varies so little that thermostats are not required. What is more, one man can look after the place, and he needs to make only one brief check-up daily.

As the experiments proceeded, other unique advantages turned up. In ordinary greenhouses control of humidity is always a problem. To overcome the effects of sunlight, complex equipment is often used to keep the air suitably moist. Because there is no sunshine in the artificially lighted greenhouse, control of humidity is very simple. As a rule the moisture stays at a high level with no attention. Again, operating and labour costs are sharply cut. All this holds true for both summer and winter. Seasonal difficulties are almost eliminated. Underground gardens are free from the troubles associated with long periods of sunless skies, too intense sunshine, unusual heat or cold, sudden changes of outside temperature. The weather is literally made to order. It can easily be varied to suit the requirements of almost any plant, at any stage of growth.

To the ordinary gardener, especially the amateur, the 'insides' of the dark greenhouse are really fascinating because it is quite feasible to make one of these outfits no bigger than a small chest of drawers. Such a garden-in-a-box need not be underground. It can be set up in any corner of the house or apartment. And it will work just like the largescale models, for the latter simply house many small, individual growing units. Each unit resembles in size and shape a roomy bookshelf. Several can be piled up as in a bookcase. The length of each unit is determined by the fluorescent fixture used. Plants grow in trays resting on the bottom of each shelf, and one or more lighting tubes are mounted above them. Each unit is closed on all sides, with the front opening on hinges.

For the commercial grower the great advantage of these propagating units is that they accommodate a good many more plants than do the racks of standard greenhouses. Temperature and humidity are uniform, and no plants compete with others for light. Light intensities can be adjusted over a wide range. For seedlings, the tray or the 40-watt fluorescent tube is moved so the plants almost touch the lamp. Cuttings and other plants should be about 12 inches below the lamp. But there is almost no end to the positions that can be tried.

Even the quality of the plants grown can be varied usefully. For example some red light, on seedlings, tends to produce soft, blanched plants. An excess of blue light will make them short and stocky. Garden hobbyists have the whole spectrum of fluorescent light to try. By using several tubes in each growing unit a great number of combinations is available. Normally, plants grow best in these artificial gardens when the lights are kept on 15 to 24 hours daily. For all ordinary growing, a few tests will give the proper balance between cost of lighting and how well the plants develop. But for the experimenter these completely controlled units offer enticing possibilities. Simply by flicking a switch, the length of both night and day can be changed. Any gardener can thus experiment with photoperiodism—a popular field of horticultural research that has led to remarkable results.

Scientists have found, for example, that many useful plants thrive in certain regions not so much because of particular climates, but because they require definite amounts of daylight and darkness. When their natural rhythms of sunset-sunrise are interrupted, strange things happen. Thus a plant that needs a short day can be kept from flowering, just by turning on the lights for one minute during its 'night' period. And long-day plants can often be made to flower profusely, when desired, by the same treatment. Similar experiments can be done with common vegetables. The bulbing of onions can be slowed or speeded by changing day-and-night periods.

Quite aside from such opportunities the new greenhouses are sure to become popular with growers who want useful results. Florists and market-gardeners will no doubt be testing the underground planting system on a commercial scale. The backyard farmer, too, can now make himself a cheap and compact outfit for raising plants all winter long.—Released through *U.S.I.S.*

FOOD SNIPPETS

1. India is the largest producer of groundnuts in the world, accounting for about 40 per cent of the production, which in 1947-48 amounted to 3,454,000 tons.
2. For the month ending June 10, India expects to receive 271,600 tons of wheat and 105,900 tons of rice from overseas.
3. The average annual consumption of fish in India per head is 3·4 lb. as against 95 lb. in Japan.
4. Eighty per cent of the sugarcane area in India is cultivated with the Coimbatore variety of cane, which is resistant to disease and drought and is adaptable to a wide range of soil and climate. (*P.I.B.*)

Home Gleanings

NATURE CONSERVATION, NATIONAL PARKS AND BIO-AESTHETIC PLANNING IN INDIA—I*

By M. S. RANDHAWA

THE problem of 'Nature Conservation, National Parks and Bio-aesthetic Planning in India', is one not of merely botanical interest. It deals with a problem which requires the urgent attention of the biologists, administrators, legislators and all thinking citizens. The problems of conservation of nature attracted attention of biologists in most progressive countries of the world. In the United States of America this problem was tackled as early as 1872 when the first national park for the preservation of fauna and flora was established. In United Kingdom a special committee was appointed in 1945 with Dr J. J. Huxley as Chairman and Professor A. G. Tansley as Vice-Chairman to consider the general problems of wild life conservation and the scientific and administrative requirements. The special committee submitted its report on 'Conservation of Nature in England and Wales' to the Minister of Town and Country Planning who presented it to the Parliament in July 1947. This report contains many suggestions which can with advantage be adopted in this country as well.

The concept of nature conservation embraces several distinct purposes such as conservation of plant and animal life, the scientific aspect which includes biological research, field research and experiment; the amenity aspect which deals with aesthetic and recreational side and the educational aspect. The aesthetic and recreational approach placed the main emphasis upon preserving the characteristic beauty of the landscapes, and upon providing ample access and facilities for open-air recreation and for the enjoyment of beauty in those areas. The major features of the park are made easily accessible by providing roads, trails and bridges, and living accommodation in the form of hostels, etc. The scientific approach which in no way under-estimates the aesthetic values, was primarily directed to the advancement of knowledge and its application to human welfare. The educational aspect, as the special committee on wild life conservation observes, 'is in many ways complementary to each and all of the others. True appreciation of scenery rests in part upon, and is certainly enhanced by, some understanding of what may be likened to its bony structure—the forms and dispositions of the rocks and the variety of landscape which these include, the shapes of the valleys and summits, the flow of the streams, the cliffs and dunes and flats of the coast, and all the rich verdure with which they are clothed, are things which can invigorate and refresh the mind and upon which a deep culture can be based. The more widely this appreciation can be diffused, the sounder will be the mental and physical health of the nation'.

The type of areas which are in need of conservation can be classified under the following categories:

National parks and natural reserves: National parks may be defined as extensive areas of beautiful and relatively wild country with characteristic landscape beauty, which are also wild life sanctuaries for the preservation of big game, or other mammals and birds, in which access and facilities for public open air enjoyment are also provided, so that the people may be able to observe wild life of all kinds in its natural surroundings at close quarters. There is also need of nature reserves in the national parks, which act as breeding reservoirs for shy animals, which it is desired to encourage and which are not accessible to visitors.

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* Presidential address delivered at the Botany Section of the Indian Science Congress held at Allahabad in January, 1949.

Geological monuments and other areas of outstanding value: These include rocks, exposures or sections which because of their great geological interest should be preserved as geological monuments, and which should be given the same protection as to archaeological buildings and monuments. These should be protected from mining, excavations, prospecting and drilling or similar operations.

Local educational reserves: These include small areas of local country containing representatives of local flora, which are reserved for educational purposes for the benefit of schools and colleges.

National parks

Uncontrolled destruction of wild life has been going on in many countries all over the world, and as a result of this natural fauna has dwindled, and many species have become extinct. In countries of Western Europe like France and England the process of death and destruction has reached such limits that the sight of a wild bird or animal is regarded as an event of such importance, that it inspires many lovers of nature to write letters for publication in the *Times*, saying that they heard a cuckoo at such and such a place. With the modern means of rapid transport such as motor car and aeroplane, the whole world is becoming so speedily opened up to travellers, tourists and traders, and with the increasing population, so much uncultivated land is coming under the settler's plough, that the need for the preservation of fauna in natural parks and reserves is being increasingly felt.

National parks and reserves were originally established in the United States of America. There are 26 national parks in America covering a total area of 1,500 square miles. The first national park to be established in the U.S.A. was the Yellowstone National Park in 1872. Forests in the national parks are preserved for their beauty and scientific value. In the Sequoia National Park in California grow tree groves of the world's oldest and biggest trees, the Sequoia, which are 3,000 to 4,000 years old with trunks up to 17 feet in diameter. In Mt. McKinley National Park in Alaska there are extraordinary areas for the study of glacial action. In the Grand Canyon National Park of Arizona can be seen the most interesting examples of water erosion. Here the Colorado river has cut 19 canyons, of which the Grand Canyon is a mile deep, and is flanked by intricately carved and most gorgeously coloured rocks. In Saguaro National Park in Arizona can be seen segments of the oldest desert of the world with desert animal life and a large variety of Cacti and other Xerophytic plants. All these parks are wild life sanctuaries which provide shelter to animals like bears, bisons, deer, elk, moose, antelope and mountain sheep.

In 1940 the U. S. Bureau of Biological Survey was fused with the U. S. Fish and Wildlife Service, which concentrates mainly on vertebrates including game and fur-bearing animals. The refuges of these animals are of immense size, and the habitats are artificially controlled or improved to accommodate or attract particular birds and mammals.

The lead of the U.S.A. has been followed by other countries such as Canada, Australia, New Zealand, and the Union of South Africa. In South Africa, the Sabi Game Reserve was founded in 1898, and in 1926 it was renamed as Kruger National Park. The Albert National Park in Belgian Congo was created mainly due to the efforts of an American Naturalist, Carl Akeley. Due to the creation of this sanctuary for wild animals the Gorilla has been saved from extinction. The Swiss National Park is about 62 square miles in area, and arrangements are provided in it for enabling the student and tourist to enjoy the more spectacular fauna and flora.

National parks in India

In India the necessity of creating national parks has found a tardy recognition. Dr Baini Prasad has thus summarized information about national parks in India:

"In 1934 a very great advance was made in the United Provinces through the great personal interest taken by the enlightened Governor of the Province, Sir Malcolm Hailey, as a result of which the National Parks Act of 1934 was passed. This Act provided for the establishment of national parks and for the preservation of wild life or other objects of scientific interest and for incidental matters provided therein. As a result, the Hailey Park was demarcated as a national park in the famous Patli Doon and the hill forests to the south of it consisting roughly of an area of 99·07 square miles. Under the Act the word ' animal ' was defined as ' mammals, reptiles, or birds ', and it was an offence to kill, injure or disturb any animals or to take or destroy any eggs or nests of any birds in the park. The conditions under which the people were allowed to enter or reside in the park were laid down in the Act and were to be enforced by the Forest Department. In Assam certain areas had already been demarcated as game sanctuaries and more stringent action was being taken to preserve wild life which according to some reports had been reduced by almost 75 per cent within recent years. Reference may also be made here to the Chamrajanagar Sanctuary of the Mysore State Forests which had been established with a view to offering complete immunity for animals and thereby making it possible for them to thrive without interference. Introduction of other animals not found in the area was to be attempted, and the sanctuary was to provide facilities for the scientific study of the life-histories of different indigenous species of game ".

National nature reserves

There is a clear need of establishing nature reserves within national parks. The principal purposes of such nature reserves, as given by the Wild Life Conservation Special Committee of England and Wales are as follows and are applicable to India also :

(a) ' To conserve and manage, for the enjoyment and interest of visitors, and for the use of naturalists, students and teachers, sites of biological, physiographical and geological importance and characteristic stretches of the natural vegetation. Similar considerations would apply in a less degree to other areas which, though not so valuable on strictly scientific grounds, have just as much importance because of their general charm or because they contain objects of marked beauty —whether rocks, trees, or flowering plants.

(b) To establish breeding reserves for scientifically encouraging particular species or communities of species the preservation or wider spread of which within the park it is desired to promote. In such reserves public access would have to be more or less restricted.

(c) To set aside areas so managed as to attract rare, interesting and beautiful species not at present living in the park or its surroundings '.

The authorities who are made responsible for the management of the reserves should keep close touch with University or educational centres, as well as main local natural history societies. A need would also arise of providing small handbooks on nature reserves, explaining with the aid of maps, photographs, and sketches the scientific significance of the reserve.

Local educational reserves

Lack of field training for teachers as well as students, is one of the most serious deficiencies in current biological education in India. Without field training or facilities for nature study, teaching of Botany or Zoology tend to become lifeless and warped. Thus there is need of local educational reserves for all colleges where biological sciences are taught. The local educational reserve is the counterpart of the college museum and the laboratory. These reserves would open a vast and a stimulating field of knowledge in a discipline which trains such mental attributes as acute power of observation, patience, concentration, detailed ordering of thought, and the appreciation of form and colour. Visits to these reserves under proper guidance would provide a liberal education to the students in one of the most stimulating and formative fields of thought. These are gains which cannot be quantified in terms of money. A beginning in this direction has been made in Delhi Province, where the local Government has placed an area of 20 acres on the ' Ridge ' at the disposal of the University of Delhi, Department of Botany. This piece of land will be enclosed with barbed wire, representative trees and shrubs would be labelled and efforts would be made to introduce other local plants also which can grow under these conditions.

Need of new policy

With the liquidation of the feudal order and the merger of States into Unions, the problem of wild life preservation has acquired a new significance. Whatever may be the faults of Princes and Rajahs, it must be said to their credit that they preserved the wild animals and forests of their States. With the growing demands of cultivators who want to save their crops from harmful animals there is need of clear formulation of policy. There is immediate need of initial survey of all proposed national park areas. While there is necessity of maintenance of a good vegetational balance and preservation of rich flora and fauna in the national park areas, the general wild life policy must be such as will not prejudice the use of developed agricultural land. The interests of the cultivator and the lover of nature must be harmonized. The apprehensions of farmers that national parks and nature reserves will develop into uncontrolled sanctuaries where pests and weeds will be allowed to flourish, and which will spread into surrounding agricultural lands must be allayed. The biologists must give lists of harmful and useful birds and animals. While the friends of the cultivator should be encouraged in the national parks, the enemies must be exterminated. The biologists should also give a finding whether campaigns should be started for the destruction of wild boars, porcupines, monkeys, bats and parrots who cause enormous damage to crops and gardens. Before any such campaigns are started, it should be ascertained whether wholesale destruction of certain birds or animals may not have harmful repercussions elsewhere, on account of the upsetting of balance of power between various organisms. An action which *prima facie* may appear sensible and desirable may have far-reaching and most unpleasant and unforeseen consequences fifty years hence. As the authors of the report of the Wild Life Conservation Special Committee observe, " A conservation policy directed to maintaining any particular biological equilibrium entails constant vigilance and a fine-scale ' management ' of a kind comparable to the most highly developed farming ". The Special Committee further recommends the establishment of a National Biological Service, which should include not only Systematists, but also others. As the Committee further observes, " Though the ability to recognize and name an organism is the first essential stage, it is by no means the last. The ecologist, the plant or animal physiologist, the geneticist, the student of behaviour, the soil scientist, the climatologist, and the statistician each has his prominent place in the picture. But standing level with the biological sciences, though too often neglected in the context of nature preservation, are the geological and physiographical sciences ; for it is from the nature and distribution of the rocks and from the configuration of the earth's crust that the natural beauty of scenery and its living carpet are derived ".

The Committee further enumerates the functions of the proposed Biological Service as follows :

' (a) The scienitfic and practical management and maintenance of the series of National Nature Reserves in such a way as to provide :

(i) Reservoirs for the conservation of the main types of wild life (plant and animal species and communities) represented in the country.

(ii) Facilities for the conduct of fundamental and applied research and survey.

(iii) Certain educational facilities for students.

(iv) Facilities for the amateur naturalist and members of the public to observe and enjoy nature.

(b) The provision of advice and the conduct of any scientific work that may be required by the National Parks Commission in relation to National Parks and Conservation Areas.

(c) Making local representations on scientific questions affecting conservation (e.g. to local planning authorities and Advisory Committees) and the watching of sites of special scientific importance which are not National Reserves, with the object of interesting their owners in a sound conservation policy.

(d) The central representation of informed biological opinion in relation, e.g. to protective legislation and the effects of pest control.

(e) The biological survey of National Reserves and the conduct of wider surveys, distributional recording, etc. with the ultimate aim of carrying out a thorough survey of wild life throughout the country as a continuing process, since plant and animal communities are essentially dynamic organizations subject to rapid and far-reaching changes.

(f) The conduct of, as well as the provision of facilities for long-term and short-term field research.

(g) The conduct of such research on problems affecting forestry, agriculture, drainage, water-supply, erosion and coastal accretion, landscape and amenity conservation, etc. as could with advantage be undertaken by the Biological Service.

(h) The maintenance of a central bureau of information for the digesting and indexing of all data relevant to the work of the Service whether derived from that work or from external sources.

(k) The maintenance of liaison with the central and local authorities concerned, with reserve-holding bodies, with academic and other centres of research, and with the public '.

Need of a Central Biological Service for India

In India also there is need of a Central Biological Serivce under the Ministry of Agriculture of the Government of India to deal with problems relating to conservation of nature, national parks and fisheries. Dr Baini Prasad, who realized the importance of this problem is also of the same opinion. He observes, ' The multifarious problems involved cannot be tackled properly until the all-India nature of the problem is realized and a separate department of the Central Government made responsible for this work. While leaving the school problems to various Provincial Governments and Native States, a Central Department should be responsible for dealing with the policy of conservation of wild life for India as a whole '.

The Central Biological Service may be coordinated with the Indian Forest Service, and may form a part of it. It should be staffed by scientists with appropriate qualifications, and should be equipped for survey and research in the field and in the laboratory, with the object of determining the distribution, ecology, genetics, general structure and behaviour of natural populations and physical conditions in which they live. The reserves will be used by the scientists of the Central Biological Service or field laboratories for the study of wild life and its control, or to elucidating the causes which promote or modify the maintenance of the living equilibrium in such areas. In conjunction with the Universities fundamental research on problems of nature conservation can also be fostered. Best results will, however, be obtained if free flow of staff between the Universities and the Central Biological Service is allowed. This will be of mutual advantage. The scientific workers in Universities will benefit by field experience, while the field workers of the Central Biological Service will maintain contact with problems of fundamental research, and recent advances in research in biological sciences.

Protective legislation

In January 1935, the Government of India convened an All-India Conference for the Preservation of Wild Life at Delhi, with a view to reviewing the position of fauna and flora as it existed at the time and considering generally the problem of protection of the animals peculiar to India. The Conference prepared two lists of species, first of animals that were to be protected as completely as possible, and second of those which could only be hunted, killed or captured under a licence, in some cases subject to a bag limit. The Conference further laid stress on the establishment of wild life sanctuaries. It was further recommended that the duty of preserving of fauna should be assigned to Forest Departments in the areas under their charge, and the necessity of cooperation of police and magistracy was also urged.

A comprehensive protective legislation was enacted in 1933, in the Punjab Wild Birds and Wild Animals Protection Act. All wild birds and animals were classified into three categories :

(1) Wild birds and animals which are excluded from protection.

(2) Wild birds and animals which may be killed and captured without a licence during a specified period.

(3) Wild birds and animals which may be killed or captured under a licence, subject to a bag limit in some cases, during a certain period. Shooting of these is prohibited during the breeding season, which is the close season.

To administer the Act, a Game Warden was appointed for the provinces of the Punjab and Delhi. A Game Inspector was appointed in each district with a number of game-watchers. In addition, District Fauna Committees were established in each district with the Deputy Commissioner as Chairman for advising generally about the protection of fauna in their respective districts, and for making propaganda among the general public urging the necessity of preserving wild life. The District Fauna Committee of Delhi has done exceedingly useful work. Pictorial charts showing the close season and the birds and animal friends and foes of the cultivator were designed for wide circulation in schools, *panchayat-ghars* and police stations.

There is need of protective legislation on the lines of the Punjab Act of 1933 in other provinces also. Moreover the Act should be made more comprehensive and cognizance should be taken of the plant world too. Plants which are rare, striking, beautiful, or odd should be scheduled for protection in areas where this is necessary. Rare plants like species of *Lycopodium*, *Ophioglossum*, and *Osmunda*, and other beautiful plants like *Orchids*, *Rhododendrons* and *Meconopsis*, etc. which are liable to excessive collection by botanists and which are widely plundered and uprooted by 'pleasure' pickers should also be given protection. Their collection should be permitted only under proper control.

Plant sanctuaries in the Himalayas

Some of the Himalayan valleys are in grave danger of losing their character on account of excessive grazing and growth of *Rumex*. Apart from other vegetation, the sheep and ponies which are taken to alpine meadows above the tree line by graziers in the months of April and May, graze mainly on *Rumex*. A symbiotic relationship has developed between the sheep and *Rumex*. While the sheep feed on *Rumex*, in their turn they manure the pasture land with their droppings, which in turn further encourages extensive growth of *Rumex*. The result has been that more attractive, but less edible alpine plants are driven out by *Rumex*, which now covers big areas in Himalayan alpine valleys like that of Pindari Glacier. In the interest of tourist industry, it is very necessary that some of the beautiful alpine Himalayan valleys should be declared as plant sanctuaries; and not only collection of beautiful and rare plants should be controlled, but at the same time, the grazing of sheep and cattle should also be prohibited. This is necessary in the interest of not only tourist industry, but also for checking of soil erosion as well as botanical studies.

Nature conservation and soil erosion

Nature conservation and conservation of soil, forests, grasslands and water are intimately connected. Most changes in nature are slow, insidious, and not readily detectable. A change in the balance of power between small organisms in the soil, a slowly dropping water table—these are potent factors in the destruction of a countryside. What has to be done to conserve the soil and water resources so as to maintain or establish a series of varied and most delicately balanced conditions? This question is just as fundamental to agriculture, horticulture, forestry, game preservation, fisheries, etc. as it is to the management of the national parks.

Soil erosion occurs as a result of removal of plant cover on account of deforestation by man, or by uncontrolled grazing by cattle and goats, or the utilization of grasslands for agriculture. To understand the disastrous result of soil erosion it is necessary to know what is soil.

Soil is more than mere disorganized rock material. It has been aptly described as a living organism. Apart from the soil particles, there are numerous bacteria, protozoa, diatoms, and other soil micro-organisms along with the decayed remains of plants which compose the soil. Leaves of trees, bushes and herbs form a protective cover which acts as a sponge absorbing the run-off water. This water percolates through the humus layers to the minerals of the soil and accumulates in underground storage reservoirs, which give birth to numerous fresh-water streams. With the plant cover removed by the action of man and animals, the run-off discharge of water increases at an alarming rate. Dr Gorrie has made observations on run-off data in the Pabbi Range, Jhelum District, and has found that in an area which is fairly covered with trees, the maximum run-off was less than 100 cusecs per square mile, while in the land, where persistent cattle and buffalo grazing has destroyed the cover, the run-off rose to 1,600 cusecs. Moreover, silt-laden water has a sealing effect on the pores of the soil and the amount of seepage is considerably reduced. The silt-laden water has also a sand-papering action on the floor and sides of the channel. Valuable salts containing potassium, phosphorous, calcium and nitrogen are also lost as well as micro-organisms, which play an important part in the proper development and functioning of the roots.

When more surface soil is washed away, clefts appear in the top soil, and gullies are formed. During monsoons the rain water rapidly flows away, flooding the countryside. Thus water conservation becomes a serious problem, water level falls and the country in general becomes dry and barren. The land becomes useless for agriculture and does not even produce enough grass. The repercussions of all these changes on wild life are serious. With the disappearance of grasslands, forests, and fresh water streams, wild life also begins to disappear. The erosion problem of the Siwaliks is a case in instance.

Records which are available show that in the middle of the nineteenth century, these ranges were covered with thick vegetation, which harboured a number of wild animals. These forests were protected by the feudal landlords and Rajahs for *shikar*. In the conditions which prevailed in the last phases of the Sikh rule and the early days of British occupation of the Punjab, the hillmen further encroached upon the forests. Grazing of goats and cattle and the cutting of trees continued unchecked for a long time. In the early nineteenth century, the Chos, which are now torrential monsoon rivers, were perennial fresh-water streams which furnished valuable irrigation in the submontane area of Hoshiarpur. With the disappearance of the plant cover, these perennial fresh-water streams became torrential monsoon rivers, which wash away large quantities of soil and have covered with sand the fields which were once fertile. The forest-covered Siwaliks have degenerated into bare hillocks which are not capable of producing enough for even the starving population of human beings, goats or cattle; much less of providing food and shelter for wild life.

What remedies should be adopted to check soil erosion? Closure to grazing and its substitution by grass-cutting and stall-feeding, replacement of goats by sheep, which are less destructive, have been suggested. Agricultural practices in areas in the Himalayan and submontane areas also need to be modified. Terracing, bunding, contour ridging, contour furrowing, crop rotation and strip cropping also require attention. However, the sovereign remedy is re-afforestation, and 'PLANT MORE TREES' should be our slogan for next decade. (*To be continued*).

COMMITTEE ON FISHERY STATISTICS

IN pursuance of the recommendations of the All-India Fisheries Conference held in September, 1948, the Government of India have appointed a Statistical Committee under the Chairmanship of Mr. W. R. Natu, Economics and Statistical Adviser of the Central Ministry of Agriculture which will work out details of programme for the collection of data relating to fisheries in India.

The Committee will report on the technical aspects of the programme of statistical work in fisheries including examination of the existing statistics and to recommend standard forms of returns in which they should be collected and regularly compiled. It will also prepare model schemes for conducting intensive surveys of fisheries in representative areas and important centres of production, distribution and consumption.—*Food Bulletin.*

Book Reviews

JOURNAL OF THE INDIAN SOCIETY OF AGRICULTURAL STATISTICS

Published by the Indian Society of Agricultural Statistics, New Delhi.

IT is now well-recognized that Statistics plays an essential role not only in the collection of accurate agricultural statistics but also in correct designing of experiments intended for testing the methods of increasing the yield of crops and productivity of animals. This requires statistical research of a fundamental type as well as application of statistical methods of specific problems of agriculture and animal husbandry. Articles of the first type are generally published in the *Annals of Mathematical Statistics, Journal of Royal Statistical Society, Journal of American Statistical Association, Sankhya,* etc. while those on the practical application in the *Journal of Agricultural Science, Journal of Agricultural Research, Indian Journal of Agricultural Science,* etc. There was, however, a long-felt need for a journal, which could bring together in one place all the important articles both theoretical and practical dealing with Agricultural Statistics. This need has been satisfied by the appearance of the *Journal of the Indian Society of Agricultural Statistics,* and the editors of the Journal, Dr P. V. Sukhatme and Dr V. G. Panse are to be congratulated for the fine quality and get up of this Journal.

Besides original articles on the theory and application of statistics, the present number of the Journal contains the presidential address delivered by the Hon'ble Dr Rajendra Prasad at the first annual meeting of the Society and a symposium on 'Statistical Organization for India with Special Reference to Agriculture' held at the time of this annual meeting. In his address, the President has stressed the need of obtaining accurate statistics of areas and yield of crops in the country. Contributions to the symposium on statistical organization include two articles by Dr Panse and Mr Natu who have emphasized the sound principle that all problems dealing with agricultural statistics including research and training should be dealt with by the Statistical Section attached to the Ministry of Agriculture at the Centre, and to the Agricultural Departments in the Provinces. These sections alone can have direct day to day contact with the agricultural activities which is essential for the efficient handling of agricultural statistics. The present number of the Journal also contains a very instructive article by Dr Panse and Dr Sukhatme on area statistics of crops. They have shown the inefficiency of the method of random sampling for estimating area and have recommended a complete field to field enumeration as the best procedure for collecting the information on crop acreages.

This Number also includes four original articles, two on multi-variate analysis, one on estimate of genetic variability of plants and one on fractional replication, all of which are of a high quality. A notable feature of the Journal is the Hindi supplement containing summaries of articles published in the Journal in English. It is perhaps the first scientific journal in the country which has attempted to translate the obtruse results of science into an Indian language in order that this may reach a wider class of readers. We have been assured in the editorial that this supplement will be a regular feature of this Journal.

From the quality and variety of the articles published in this number, the Journal promises to meet the real need for a scientific journal devoted to Agricultural Statistics, and with the present standard, one would hope with confidence that it will rank among the best statistical journals of the world. (R.S.R.)

FOOD PLANT SANITATION

Edited by MILTON E. PARKER (Published by McGraw—Hill Book Company Inc., pp. 447, $ 6.00).

IN this book the author has covered all important aspects of sanitary practice in food plants with a view to produce neat and wholesome food under neat surroundings. There are fifteen chapters covering the fundamental principles and various other sanitary aspects covering plant and equipment layout, water supply, waste disposal, insects and rodent control, effective uses of detergents, fungicides, germicides and sanitizers, effective methods of cleaning practice, training of 'sanitarians' and the ways of enforcing sanitary programme and the difficulties involved therein. Two chapters are included to cover the sanitary packaging practice and the sanitary aspects of packaging materials. A very useful inclusion is the appendix giving the important legal regulations covering food manufacture in the U.S.A.

It is a recognized fact that the public is entitled to protection from illness and death caused by eating impure foods. Consumers have also a right to get protection against practices which are offences to hygienic decency. This concept has been very conveniently included in Federal Food, Drugs and Cosmetic Act of 1938 as 'a food shall be deemed to be adulterated if it consists in whole or in part any filthy, putrid or decomposed substance or if it is otherwise unfit for food, or if it has been prepared, packed and held under insanitary condition whereby it may have become contaminated with filth'. In this comprehensive treatise the author has kept this in view throughout the discussion of the various principles and methods of sanitary control and inspection technique with a view to avoid legal action under the above provision of the Act and more so for giving the consuming public a healthy and wholesome food.

This book is a singularly useful compilation of the available knowledge in the branch of Food Plant Sanitation and is recommended as a reference or text book for Food Technologist, Plant Superintendents, Inspection Agencies, Public Health Students and research workers. Every Food Industrialist in our country should go through this and set their hands and energy to the task of providing a neat and wholesome food from a neat surrounding. (G.S.C.)

PREGNANCY DIAGNOSIS TESTS

By A. T. Cowie. (Published by National Institute for Research in Dairying), University of Reading, 1948, pp. 283 and 100 pp. Bibliography).

THE author has taken great pains to collect such extensive literature on the subject as is available in various parts of the world, and presented it in the form of a book. The subject matter has been well-classified and is described in ten chapters. The book has attained its object of providing the scientific worker with a brief summary of the more important researches leading to the development of pregnancy tests in the domestic animals, and of providing an adequate bibliography of the widely scattered literature. As a result of the survey of this literature, it is concluded that the pregnancy may be diagnosed in mare in the second month by an expert clinician as well as by laboratory tests; in the cow from the third month onwards; in ewe and goat during the last two months by clinical methods. In dogs and cats it may be possible to diagnose pregnancy from the third week by clinical methods; radiography in this case is of no use till the seventh or eighth week, while hormonal tests are of no value. In sow no reliable methods are available except that the *Oestrogen test* carried out between the twentyfirst and thirtieth days after service, may be helpful. (H.K.L.)

INSECT PESTS OF COTTON IN INDIA

Edited by H. D. Nagpal. (Published by Indian Central Cotton Committee, Bombay, pp. 81, Rs. 2).

THE book gives a comprehensive list of the insect fauna associated with cotton crop and is the first publication of its kind in India.

The author however deserves credit merely for compiling the information, which is rather inadequate for scientific workers and is too simple and almost preliminary. The classification of pests is rather vague and does not give clear idea about the status of the pests. At places the importance of the major pests is shadowed by including them after the minor pests. The Indian names pertain mostly to North India and the references are also incomplete.

The publication needs critical examination and considerable improvements for making it useful for further research on cotton pests by adding fuller details. It will be still better if the notes on important pests or those which are likely to be of some significance are supplemented with sketches of plants to help in the identification of the pests. (K.N.T.)

News and Views

POWERFUL WEAPON AGAINST TSETSE FLY

By TREVOR I. WILLIAMS

WHEN news of the development of the drug 'Antrycide', to combat the ravages of nagana among cattle in tropical Africa, was released its possibilities were immediately realized. At the time, however, little was mentioned about the technical side of the work.

The London scientific weekly *Nature* has now published a paper by the British scientist, Dr Davey, and the late Dr Curd, who led the team responsible for work on the drug. It discusses the drug in considerable detail and gives some idea of the painstaking work that has gone into its development.

It was in 1945 that a team of British chemists, headed by Dr Curd, Dr Davey and Dr Rose, announced their discovery of 'Paludrine', the new synthetic drug with exceptional powers of preventing and curing malaria. Now, just three years after this important discovery, the same laboratory has announced 'Antrycide', another advance which has, in a different direction, equally great possibilities for the benefit of mankind. 'Antrycide' will cure trypanosomiasis, a disease of cattle which has hitherto ravaged tropical Africa and made vast areas of that continent completely unsuitable for cattle raising.

The real ruler of large areas of Africa is an apparently insignificant insect known as the tsetse fly. This is harmless enough in itself, but just as the mosquito carries and so spreads the organisms which cause malaria, the tsetse fly carries those which cause trypanosomiasis. In man, the disease caused by these organisms is known as sleeping sickness and in cattle as nagana.

Various species

There are various species of the microbe of which the most dangerous, so far as cattle are concerned, are those known as congolense and vivax. Trials with 'Antrycide' have shown that single doses of about one-tenth of an ounce will protect cattle for six months against congolense infection and for four months against vivax infection. Cattle themselves are not affected by the drug and, after simple instruction, any cattle-owner will be able to cure his sick beasts and safeguard his healthy ones. Other forms also of the organism, which attack camels, horses, donkeys and dogs, are combated by 'Antrycide'.

Research, which resulted in the discovery of the new drug, began at Manchester in the laboratories of Imperial Chemical Industries in 1944. The search for a new anti-malarial drug—which culminated in 'Paludrine'—had led chemists there into completely unexplored fields of organic chemistry. In particular, they were led to investigate complicated new substances whose molecules consisted of atoms of carbon, joined together in rings, which also contain other atoms, such as oxygen, nitrogen, or sulphur, rather like different sorts of beads forming a necklace. In some of these new substances they discovered slight anti-malarial activity and then by a long series of logical chemical steps they made further more potent drugs.

Complicated name

The same kind of process in this new field was followed in the case of 'Antrycide'. After a long series of careful chemical experiments, it was found that new and very complex substances had remarkable powers of destroying the microbes which cause trypanosomiasis without harming infected animals. The full chemical name of this substance runs into 50 letters, interspersed with figures, hyphens, dashes and brackets, which all convey a great deal of useful information to the specialist but mean nothing to the uninitiated.

Essentially, however, the cryptic formula means that the smallest possible particle—the molecule—of 'Antrycide' consists of atoms of carbon, hydrogen and nitrogen arranged in two ring patterns which are joined together by a solitary atom of nitrogen. One of the ring patterns is known as a pyrimidine; similar but not identical patterns occur naturally in the bodies of men and animals, where they play very important parts.

The other ring pattern is known as a quinoline; this type of pattern too occurs naturally—for example in the natural anti-malarial drug, quinine. Neither the pyrimidine nor quiniline parts of 'Antrycide' alone has any effect on trypanosomiasis microbes, but joined together by a single nitrogen atom they form a powerful drug.

Experiments in Africa

The first tests of the new drug were made on mice, rats and rabbits at the Manchester laboratories, but, despite the success of these, it was realized that the only conclusive tests would be those made with cattle actually infected with the disease under natural conditions.

The risk of producing trypanosomiasis in cattle in Britain, even under the strictest control, was too great to be undertaken by Imperial Chemical Industries or by the Colonial Office, which has throughout taken an active interest in this work. Accordingly, the centre of research shifted to Africa, where the disease was common and there already existed veterinary stations which could be of immediate help.

The Sudan Government also assisted. There, scientific research could be carried out under the necessary natural conditions, though the unusual surroundings sometimes led scientists into unexpected difficulties. Thus, a charging rhinoceros once interrupted an experiment and obliged the scientist in charge to seek refuge on a tree. On another occasion, some Masai people—famed lion-hunters—had to be hired to protect the experimental cattle from attacks by lions.

Foot and mouth, rinderpest and East Coast fever destroyed some of the test cattle and soldier ants devoured mice being used for laboratory experiments. Nevertheless, the tests, which are still continuing under Dr Davey's direction, have fully justified early belief in the drug's possibilities.

'Antrycide' alone can promote the growth of the cattle population in the tsetse fly regions of Africa. Before the fullest advantage can be taken of the new drug, farmers must be taught its value and how to use it and suitable pasture and water must be made available. These problems too are now receiving careful attention. Without 'Antrycide', however, the solution of these other problems would be valueless. (*B.I.S.*)

WORLD RICE PRODUCTION SURVEYED

EVEN if the world production of rice is raised by 10,000,000 tons of paddy in the next two years it would still not make it possible for the peoples of rice-eating areas to secure the pre-war level of consumption. This is one of the facts contained in a bulletin just published by the Food and Agriculture Organization of the United Nations.

Asia accounts for, the bulletin reveals, 94 per cent of the area under rice and of the production of rice. In the current year the area is estimated to have reached the pre-war figures but for a number of reasons output is reckoned at 6·2 million tons less than in pre-war years. Bad weather, shortages of tools, irrigation plant, fertilizers, insecticides and the planting of poor land have resulted in a reduced yield per acre. At the same time, the population of the main rice-consuming countries has increased by 10 per cent.

Improvements in yield from land under cultivation and expansion of rice lands might give an increase of 10,000,000 tons, but the bulletin emphasizes that such an increase would still fall far short of the demand not merely because it would fail to bring supplies up to the quantities per head which were available before World War II but because there is need to raise the consumption level.

The survey underlines the urgent need for peace in China, Indo-China and Burma where the area under cultivation is still smaller than before the war. *(L.P.S.)*

COVER ILLUSTRATION

Cassia fistula (*Amaltas*)

(Sketch by N. S. Bisht)

INDIAN FARMING

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INDIAN FARMING

JULY, 1949

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FOREST PROBLEMS OF ASIA*

THE F.A.O. deserves our appreciation for organizing this Regional Conference to deal with certain basic problems affecting the economic life of so many nations. Through these conferences F.A.O. endeavours to play its part in raising the standard of living of the common man. It is in a way in the fitness of things that the first Regional Conference on Forestry for Asia and the Pacific should be held in India. Forests have played a part in the social and spiritual life of our country which they may not have played elsewhere. Wise men in India did not look upon forests simply as an unwanted waste of land which man can put to better use or as the abode of wild untamed lives hostile to human peace and welfare. In the eyes of India's sages forests had a great place in the life of man. They could serve his physical needs and they could serve his spiritual needs also. It is in the forests more than on the field that man is brought closer to nature. Out of that close contact emerges a balanced judgment on the varieties of human life and one is better able to fix man's place in nature and the place of forests in the evolution and progress of human society. And so it was in the retirement of forests that the great seekers of Truth found the Truth and sang and spoke about it till it has come down to India's present generation through the sacred books of the country.

Today, however, forests have ceased to have any spiritual inspiration or messages. They are the means of our physical welfare through their effect on climate, agriculture and industry. But even in that role man has not permitted forests to play their part. Almost in every country and more so in the countries of the East there has been a progressive denudation of forests and to that extent our soil has lost its natural guardian. The erosion of topsoil has become a grave danger to agricultural production to meet the ends of a growing population. Half the population of the world crowds upon the fields of Asia and more and more of the forest area is encroached upon to enable man to feed himself. The soil thus becomes more and more subject to erosion. To nations of Asia and the Pacific even a country like the United States holds up the finger of warning. I feel justified in taking a minute or two more of your time in repeating to you the verdict of that country's own Government on the menacing situation which confronts it. The United States has a billion acres under crops and pasture. An official report indicates that considerably more than one quarter of that billion acres have now been ruined or severely impoverished and that the remainder are damaged in varying degrees. Here are the very words of the report: 'The loss we sustain by this continuing erosion is staggering. Careful estimates based on actual measurements indicate that soil losses by erosion from all lands in the United States total 54,00,000,000 tons annually. From farm lands alone annual loss is about three billion tons, enough to fill a freight train which would girdle the globe 18 times. If these losses were to go on unchecked, results would be tragic for America and for the world.

'The results would not only be disastrous, they already are far too costly for the country to continue to bear. For example, in a normal production year erosion by wind and water removes 21 times as much plant food from the soil as is removed in the crops sold of this land. It is plain that farm lands which have lost so much topsoil and plant nutrients cannot produce as bountifully as they did before they were slashed and impoverished by erosion. In that fact lies the significance of America's erosion problem for America's citizens. We do not have too much good croplands available for production of our essential food and fibre crops in the future. If we do not protect what we have and rebuild the land which can still be restored for productive use, the time inevitably will come—as it already has come to some areas of the world—when the United States farm lands cannot produce enough for us and our descendants to eat and to wear'.

---

*Inaugural address by the Hon'ble Shri Jairamdas Daulatram at International Forestry Conference at Mysore.

Our Conference has a large agenda before it. Many of these items are of a technical character: none of these is unimportant. And yet the overshadowing character of the basic problem of soil conservation and its integral relationship to a sound forest policy gives a challenge to us which we cannot afford to ignore. That a country so advanced in agricultural science, equipment and methods should have before it such anxious future is a call to the thickly populated nations of the East to think, plan and act betimes with prudence and promptness and reorient the national forest policy to meet the urgent needs of the situation. In our own country the problem is no less grave than anywhere else and it needs to be handled on a rational basis and with maximum coordination with Provinces and States. I realize that in India as elsewhere this cannot be a short term programme. Our country has resolved to achieve freedom from imports of foodgrains by the end of 1951. The provinces and States are being approached to join in attaining this objective of supreme national importance urgently. Though we are planning to concentrate on intensive cultivation with better use of water, manure and seed, it would be unwise not to design a national programme of soil conservation for simultaneous implementation.

You who are gathered together here are men of experience and learning and I would welcome it as a matter of fruitful result of the Conference if your decisions laid full emphasis on the framing of urgent plans for a rational integration of forest and agricultural policy so as to save our soil from progressive impoverishment.

Many of the other aspects of forestry are to receive your consideration during the days your Conference would be in session. Problems relating to industrial use of forest resources and the many special problems arising out of this are to be tackled by you; also, the great and the basic problem of protection and development of forest resources. Other immediate problems relating to fuel, wood, lumber and building material are also facing you. You are best able to decide how to deal with them. As a layman, I can only place before you a guiding consideration which in my humble view should inspire your deliberations and shape your decisions.

Forests can serve the cities and should serve, but it may be a proper and wise policy to let the forests serve primarily the vast rural area in which nature has set them. The vast masses of Asia and the Pacific live predominantly in the villages. Nowhere is the slogan of freedom from want more potent than in the villages and the limitless potentialities of our forest wealth should be tapped to raise the standard of living of our rural masses. This needs to be done not only by developing rural industries based on forests but even in other ways which will link this up with the daily economic life of the agriculturist. No instance can be more striking from this point of view than the present position of fuel wood for the villager's home. Denied of proper facilities in this respect he encroaches upon the food which the land badly needs and uses the manure as fuel. He forces himself into the vicious circle of less manure and less yield.

An effective programme for rapid increase in fuel wood for the rural masses which can be reconsidered with a rational policy of forest development would be a blessing for the agriculturists in most Asiatic countries. Representatives at the Conference can be pooled to discover all useful varieties of quick-growing trees which can be used for fuel wood and save billions of tons of rich farmyard manure for the hungry under-fed fields. This is but one instance. You know better than me by what other variety of measures your work can subserve the welfare of the rural people. A positive passion for improving the lot of these masses would be the growing qualifications of those who have devoted their life to the study in laboratory and in sylvan wilds and have sought out the secrets which for man's benefit nature has embedded in the great forests of the East.

While I am laying this stress on the ruralization of forest research I would not wish the Conference to ignore the urgent calls of industry on the forest resources. These too have their places in the national economy and have to receive a response and I have no doubt that you will chalk out a suitable line of action to meet the demands of industry which is finding that iron and steel and other requisites are none too easily available. But while deliberating upon the measures of services to the rural masses or city industries, the experts and specialists in forestry from the countries of Asia and the Pacific can only be coming closer to each other forgetting for the moment their distinct nationalities and bound together by the strong ties which common research for nature's secrets naturally create. The bond of science and the brotherhood in service bridge all international gulfs and create a sense of fellowship, a spirit of human kinship and a feeling of cultural identity which I feel is at the present moment even a great contribution of such international conferences than even the concrete economic result which must inevitably result from your deliberations. India is only too anxious to help in forging such cultural links. It was our Great Teacher and Leader, Mahatma Gandhi, who preached the identity of man, whatever be his colour or creed and it is in that spirit that India should and would participate in conferences like yours of today.

It is probably true that in the particular field of forest research India has some advantage over some other countries in Asia. The results of about a century's research are available in its institutes and in its programmes of work which have been in operation for many decades. All these are at the service of our sister nations of Asia and the Pacific. We all welcome to our institutes and museums the scholars from our sister countries and give to them the benefit of all that nature or man's endeavour has made available to us. Treat our scientific possessions as your own. Knowledge can really be the possession of none.

Original Articles

THE USE OF COWS FOR WORK

IN various parts of the country recently acute shortage of bullocks has been felt. According to the 1945 census, the number of working animals had decreased in almost all the provinces. The shortage of bullock power, which was accentuated during the war due to greater pressure being placed on bullock transport in the towns, is likely to continue, specially in areas where famine has taken a heavy toll of cattle wealth.

Shortage of bullocks

At present, fodder famine is prevailing in Saurashtra, Gujerat and Kutch in an acute form. In these places large number of bullocks have died and to meet the normal agricultural requirements of those areas, bullocks are required in thousands. But as there is no surplus in the other parts of the country, this shortage cannot be met by indenting animals from elsewhere. The East Punjab, the United Provinces and Rajasthan which have usually a surplus stock in normal times, are also feeling the dearth of work animals. There will also be greater need for bullocks, in spite of the initial use of machinery, for the land that is to be reclaimed for increasing the food production of the country so as to make it self-sufficient by 1951. No doubt one way of overcoming this shortage is to accelerate mechanization, but machinery is neither easily available, nor can it be profitably used by the ordinary cultivator, whose holdings are usually very small and more often scattered.

Working of cows in Egypt

Obviously, the solution must be found within the present agricultural set up. One way seems to be the use of cows for work. During his recent visit to Egypt, Sardar Datar Singh, Vice-Chairman of the Indian Council of Agricultural Research, observed that it was a common practice there to use cows for carrying out field operations as well as for other types of draught work. Working of the cows neither had any ill-effect on the milk yield of animals nor on their health. Not only were the animals in milk worked, but even dry animals up to two months before calving were used in this way. This practice helped the Egyptian farmer to economize on the feeding cost to a considerable extent because it involved the use of a lesser number of bullocks.

Mahatma's blessings

It was considered desirable that this idea should be seriously taken up in our country, where there is an acute shortage of both fodder and bullock power. The draught quality in Indian cattle breeds has been established beyond reasonable doubt and there appears to be no reason why cows should not be put to work for the benefit of the cattle-owners, as well as the cattle themselves. But because of the sanctity and veneration attached to the cow in this country, the problem was brought to the notice of Mahatma Gandhi to ascertain if there was anything objectionable in working the cows. He gave his blessings to the idea of working the cows, because of its economic advantage to the poor cultivator and indirect beneficial effect on the animal. The Indian Council of Agricultural Research accordingly decided to test the working of cows on Government farms. A scheme was, therefore, sanctioned to test cows at four centres on some of the recognized breeds of cattle, and the work has been initiated at the Indian Dairy Research Institute, Bangalore, on Sindhi cows and at the Government Livestock Farms in Mysore State on Amrit Mahal and Hallikar breeds of cattle.

Prevailing practice

It may also be mentioned here, for the benefit of those who may have aversion for

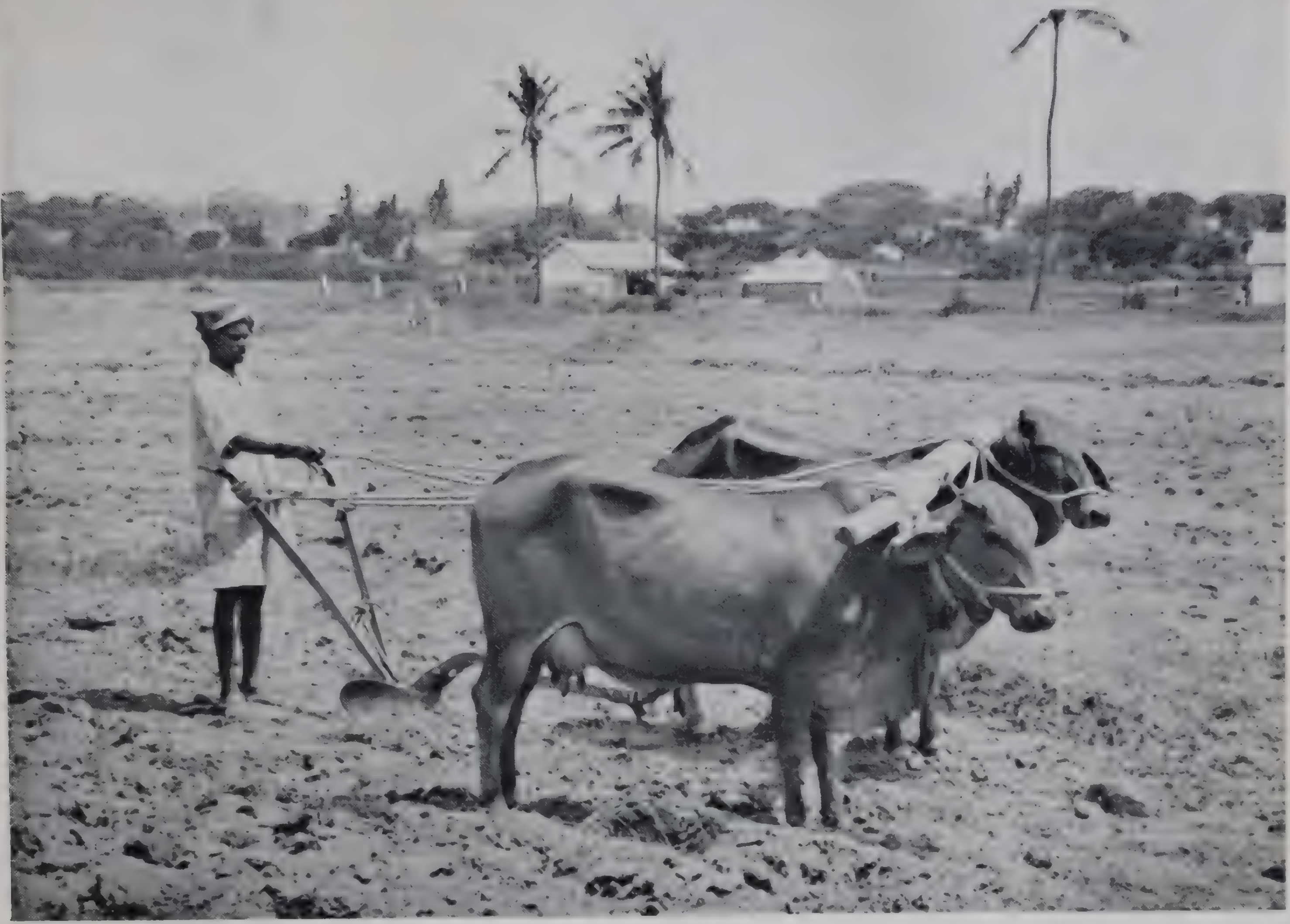
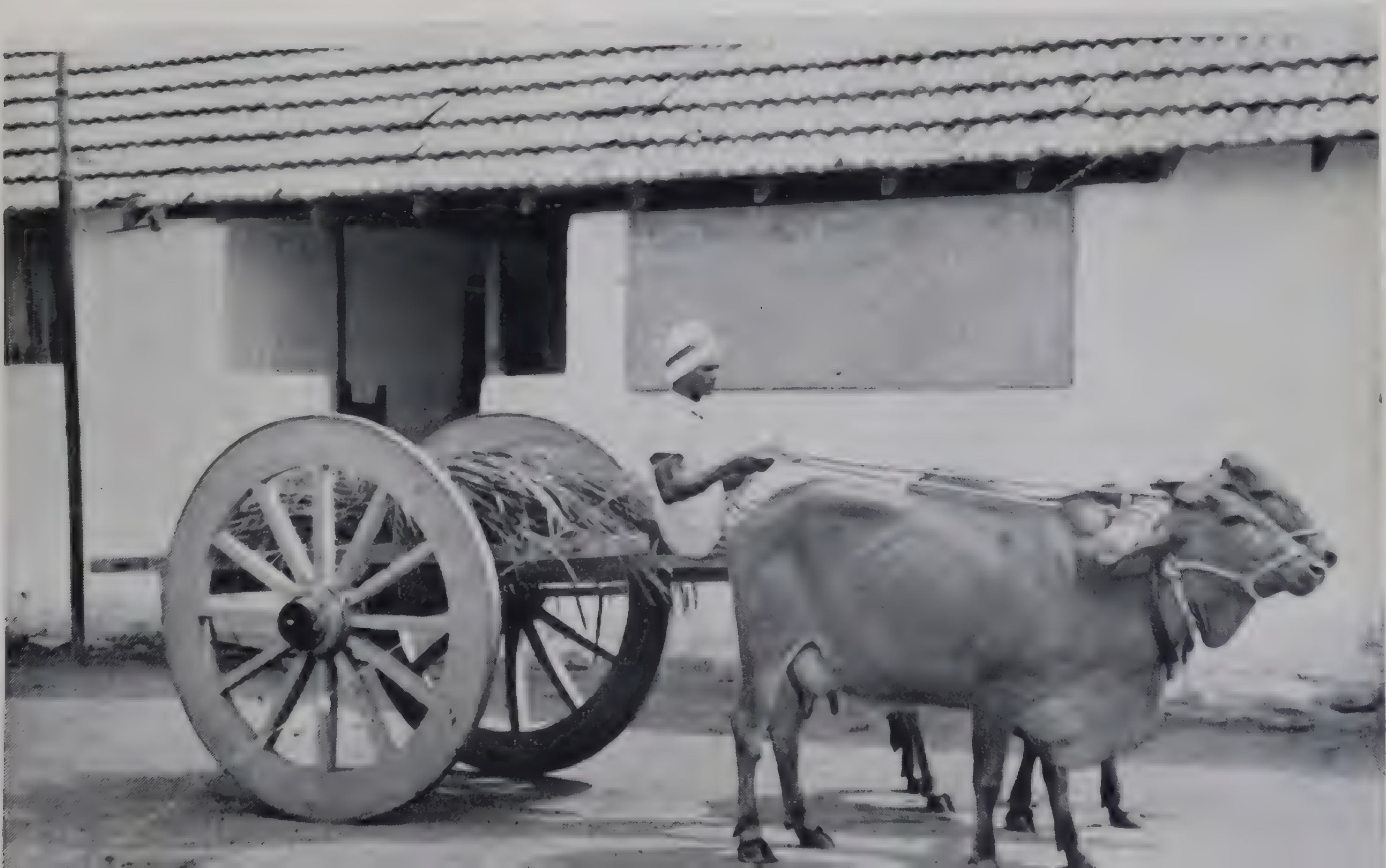


FIG. 1. Sindhi cows ploughing the field

FIG. 2. Sindhi cows in light cart work



or prejudice against the use of the cow for work, that the idea is not altogether new to this country. The cow has been used in the past and is still being used under the yoke in Mysore and Coorg; and Dhani cows in the West Punjab were used to a considerable extent for work. To make full and proper use of our animals, not only the uneconomic cattle should be put to work, but also the others whose utility should be increased by putting them to work and by better feeding and looking after.

Training of cows for work

The period of training for draught work is a particularly trying one, for much more energy is expended by the animals during this time than later when it has become accustomed to the work. When it is decided to train a cow or a heifer, it should be quietly, but as quickly as possible, broken to draught and paired with another cow. The work allotted should be normal road draught work about the farm or the cultivation of normal arable land for six hours each day on all working days. Work should not be demanded within two months of calving and till one month after.

Food requirements

The working cow must be given sufficient food to meet her requirements of maintenance, work and milk, in addition to sufficient minerals and vitamins. The ration however should not consist of more than 2·5 lb. of dry matter per 100 lb. of body weight of the cow or, if possible, even less for it is only very good cows that are able to consume so much. At the most 15 lb. of dry matter is what a normal 600 lb. cow can eat and digest. As the power to consume is limited, a normal 600 lb. cow cannot be expected to give more than 10 lb. of milk per day while working and this target can be achieved only if the maximum amount of concentrates are fed. The daily requirements will thus be 20 lb. of grass and 10 lb. of concentrates. This will provide sufficient energy for maintenance, six hours of medium type of work, five seers of milk containing 5 per cent butter fat and also leave a small surplus.

The guiding principle in feeding a working milch cow is exactly the same as that for feeding a non-working dairy cow, i.e. that the food should be increased in anticipation of increased output until no response to the increased diet is evoked.

Economics

At the price of Rs. 2-8 per maund for grass and Rs. 10 per maund for concentrates, the daily ration of a 600 lb. working cow, should cost about Rs. 1-14 or say Rs. 2, of which a quarter or eight annas per diem will be on account of work. This obviously is cheaper than maintaining a separate animal for work only.

It will thus be observed that by using cows for work, it will not only be possible to overcome bullock shortage, but also to feed them better, because of the increased economic return obtained from them. The problem of fodder shortage will also be overcome to some extent because of the lesser number of animals required. Let the old prejudices therefore be cast away, which have arrested the progress and growth of agriculture and livestock in this country and converted our cattle into an uneconomic burden rather than an asset. It is only by getting rid of such prejudices that it will be possible to transform our livestock into more productive animals. This will also enable us to give them the attention they deserve, otherwise our *ahimsa* or reverence for the cow would merely be an idle talk. (H.K.L.)

SWEET POTATO

By B. SEN

SWEET POTATO though sweet is not a potato at all. The ordinary potato belongs to the botanical family of Solanceae, and the sweet potato (*Ipomoea batatas*) to the family of Convolvulaceae. Moreover, potato is a modified shoot, whereas sweet potato is an enlarged root. Both, however, are excellent sources of human food. It is not generally recognized that sweet potato contains a higher percentage of carbohydrates, calcium and vitamin A than ordinary potato. In India, for some unknown reason, sweet potato is generally looked upon as an inferior food crop. In spite of the fact that sweet potato can help in a great measure to relieve our acute shortage of both food and fodder, up to this time it has not attracted the attention it deserves.

It was during my visit to the U.S.A. in 1946-47 that Mr. Glen Overton of Dowagiac, Michigan, first brought to my notice the practical possibilities of increasing food production in India by widespread cultivation of sweet potato. As a result of subsequent visits to the laboratories of Dr Julian C. Miller at Baton Rouge, Louisiana, and of Dr C. E. Steinbauer at Beltsville, Maryland, I became convinced of the tremendous importance of the sweet potato crop for India. Through the courtesy of the gentlemen referred to above I was given seeds and roots of several high yielding and disease-resistant strains of sweet potato recently evolved in the United States.

For even in the U.S.A., the increased interest in sweet potato is of comparatively recent origin. It was the demand of the Army for dehydrated food during World War II, and stoppage of normal imports from abroad of root starch (which America makes use of to the extent of hundreds of millions of pounds annually) that brought out the importance of sweet potato in the U.S.A. By 1945, the total value of the U.S.A. sweet potato had reached the staggering figure of approximately Rs. 44 crores a year.

Food

In February, 1941, a 5 lb. sample of dehydrated sweet potato was sent to the U.S. Army Quartermaster Corps. Immediately an order for a 2,000 lb. sample was placed. By 1942, the order for dehydrated sweet potato was 2,000,000 lb. In 1945, the U.S. Army and Lend-Lease requirements had risen to 20,000,000 lb.

Dr Miller gave me the following explanation: 'Probably no other vegetable crop carries so many nutritive units as does the sweet potato. Apart from sugarcane no other crop can produce an equal yield of carbohydrates per acre.'

Dr Miller's analysis of the comparative nutritive values of edible portions of potato and sweet potato is reproduced in Table I.

TABLE I

Composition of edible portions of potato and sweet potato per pound.

	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	gm.	gm.	mg.	mg.	Units	mg.	mg.	mg.	mg.
Sweet potatoes	567	8	3	127	159	222	3·2	17,200	0·45	0·32	5·9	113
Irish potatoes	386	9	0·5	87	36	222	3·4	180	0·41	0·23	5·4	45

It will be seen from Table I that sweet potato ranks higher than ordinary

B. SEN is Director, Vivekananda Laboratory, Almora, (United Provinces).

potato in most categories, particularly in carbohydrates, calcium and vitamin A. Moreover, the yield of sweet potato per acre has been found to be higher than that of ordinary potato. Tender end-lengths of sweet potato vines can also be used as a table spinach. A few plants would be sufficient to supply spinach requirements of a family, provided they can be watered during the summer months.

Sweet potato flour

Small samples of sweet potatoes can be sun-dried by the cultivators and made into flour for their own use, as is now commonly done in villages in India where sweet potatoes are cultivated. For handling large quantities of sweet potatoes, modern dehydrating machines can be utilized with profit. There are several machines, made in the U.S.A., specially adapted for dehydrating sweet potatoes. They can also be used for speedy drying of sweet potato tops (stems and leaves) for fodder. Experimental trials in India have shown that 20 per cent of sweet potato flour, or even more, can be mixed with *atta* for *chappatis*. The result is both nutritious and palatable.

Fodder

Apart from the higher yield of the edible roots of sweet potato, as compared with ordinary potato, the vine terminals and leaves constitute an excellent source of fodder. Nearly 1¼ tons of high quality dehydrated sweet potato leaf meal can be obtained per acre. The feed value is approximately equal to that of alfalfa hay, as will be seen from the unpublished data of Dr Julian C. Miller in Table II.

TABLE II

Feed values of sweet potato leaves and terminals and alfalfa hay

	Protein	Fats	Carbohydrates	Mineral matter
	(All given in percentages)			
Sweet potato leaves and terminals ...	12·6	3·3	45·5	10·2
Alfalfa hay ...	14·7	2 0	36·4	8·3

Thus the roots and tender vine end-lengths of sweet potato offer a very nutritious food for human beings, and the stringy roots and stems and leaves make an excellent fodder for cattle.

Sweet potato also has a number of important industrial uses.

Starch

Sweet potato starch has been found equal, if not superior, to other root starches for the manufacture of certain adhesives, laundry starch of high quality, textile and paper sizings and for use in the cosmetics, baking and confectionery industries. The percentage of starch in sweet potato has been found to vary from 19 to 32 per cent, according to the strains, climatic conditions of the region, and the date of planting and harvesting. The strain known as Pelican Processor evolved in Dr Miller's laboratory at Baton Rouge produced at the Louisiana State University Experiment Station a record yield of 780 bushels (42,900 lb.) per acre! This strain is a starch variety and its starch content varies from 26 to 32 per cent depending on the soil and season. It has also the lowest moisture content. Type B-196 has also been found to be a very high yielder and it has the further advantage of being resistant to stem rot.

Industrial alcohol

The grades of sweet potato not suitable for food can be utilized for the production of industrial alcohol. A bushel of dehydrated Pelican Processor sweet potato has been found to yield 5·44 proof gallons of alcohol.

Pectin

Sweet potato is rich in pectin, which is used for the manufacture of marmalades and jellies.

Carotene

Carotene is one of the principal sources of pro-vitamin A and is in great demand for fortifying foods. Some of the strains of sweet potato can produce as much carotene per pound as carrots. When sweet potatoes are used for manufacture of industrial alcohol, carotene is obtained as a by-product.

Syrup

Syrup can be very easily produced from Nancy Hall sweet potato, and in India could form a cottage industry, allied to the making of indigenous sweets. The sucrose content of the syrup is only 7 per cent and the syrup is not so sweet as cane-sugar syrup, but it can easily be blended by addition of say 10 per cent of cane-sugar syrup. Dr G. A. Shuey's analysis of sweet potato syrup is given below :

TABLE III

Analysis of sweet potato syrup

Water ...	... 30·12	per cent
Ash ...	... 1·75	,, ,,
Protein ...	... 2·45	,, ,,
Maltose ...	... 43·01	,, ,,
Sucrose ...	... 7·00	,, ,,
Dextrins	... 14·04	,, ,,
Undetermined	... 1·63	,, ,,

Grading of sweet potatoes

Sweet potato plants produce roots of various shapes and sizes. In the U.S.A. grades for table use have been standardized. For Grade No. 1, the diameter should be from 1¾ to 3½ in. and length from 3 in. to 10 in. For No. 2, the diameter should measure not less than 1½ in. nor more than 4 in. The very small roots, as also the very large over-sized roots called 'Jumbo', not convenient units for cooking, are utilized for dehydration or other industrial purposes. The stringy roots are utilized for cattle feed. Thus absolutely nothing is wasted.

Storage of sweet potato

Care must be taken to prevent cutting, bruising or otherwise injuring the sweet potatoes during harvesting or subsequent handling for market. Otherwise the loss during storage becomes a serious problem. For instance, it was found that the loss from uninjured sweet potatoes stored for 5½ months was 13·8 per cent due to shrinkage and less than 1 per cent from rots, while the loss from the injured roots was 28·1 per cent by shrinkage and 13·8 per cent from decay. Since it is through any break in the skin of the roots that diseases get started, the sweet potatoes after harvesting should be subjected to conditions which close the wounds effectively by the formation of a wound cork-layer. This process is called curing. Freshly harvested sweet potatoes should preferably be kept for 10 to 14 days at 80°F. to 85°F. with a relative high humidity of 85 to 90 per cent. Afterwards the cured sweet potatoes are best stored at a temperature of 50°F. to 55°F.

Cultivation of sweet potato

Sweet potato grows best in regions of light sandy or silt loam, with a growing period of four months during which warm nights prevail. According to the fertility of the soil, 5 to 6 maunds of 4-12-4 (N-P-K) of commercial fertilizer or its equivalent is recommended to produce a good yield. Green manuring has also been found to improve the crop. For sweet potato cultivation, at least a three-year rotation is recommended.

Healthy sweet potato roots are allowed to germinate in nursery beds and when the sprouts reach 5 to 6 leaf-stage, they are pulled out and planted in the fields. These are called 'draws'. From the same root second and third sets of draws can be obtained at intervals of two to three weeks. Dr Miller, however, favours propagation of plants from vine cuttings, since a greater number of vine cuttings than 'draws' from the seed roots can be obtained and the risk of infection is also minimized.

From the results of coordinated experimental work carried out by the U. S. Department of Agriculture in different regions with many strains of sweet potato over a period of several years, the general cultural practices recommended for higher yield and better quality of sweet potato roots are : early planting in ridges one foot high and four feet apart, with plants 12 inches apart in the row.

Preliminary experiments in Almora, U.P. with U.S.A. sweet potatoes

Two roots each of 13 strains of sweet potato received from the U. S. Department of Agriculture, and seeds of one strain obtained from Dr Miller were planted in Almora on 21 March, 1948. Roots of two strains of Bengal sweet potato and cuttings of two strains of Bombay sweet potato were also

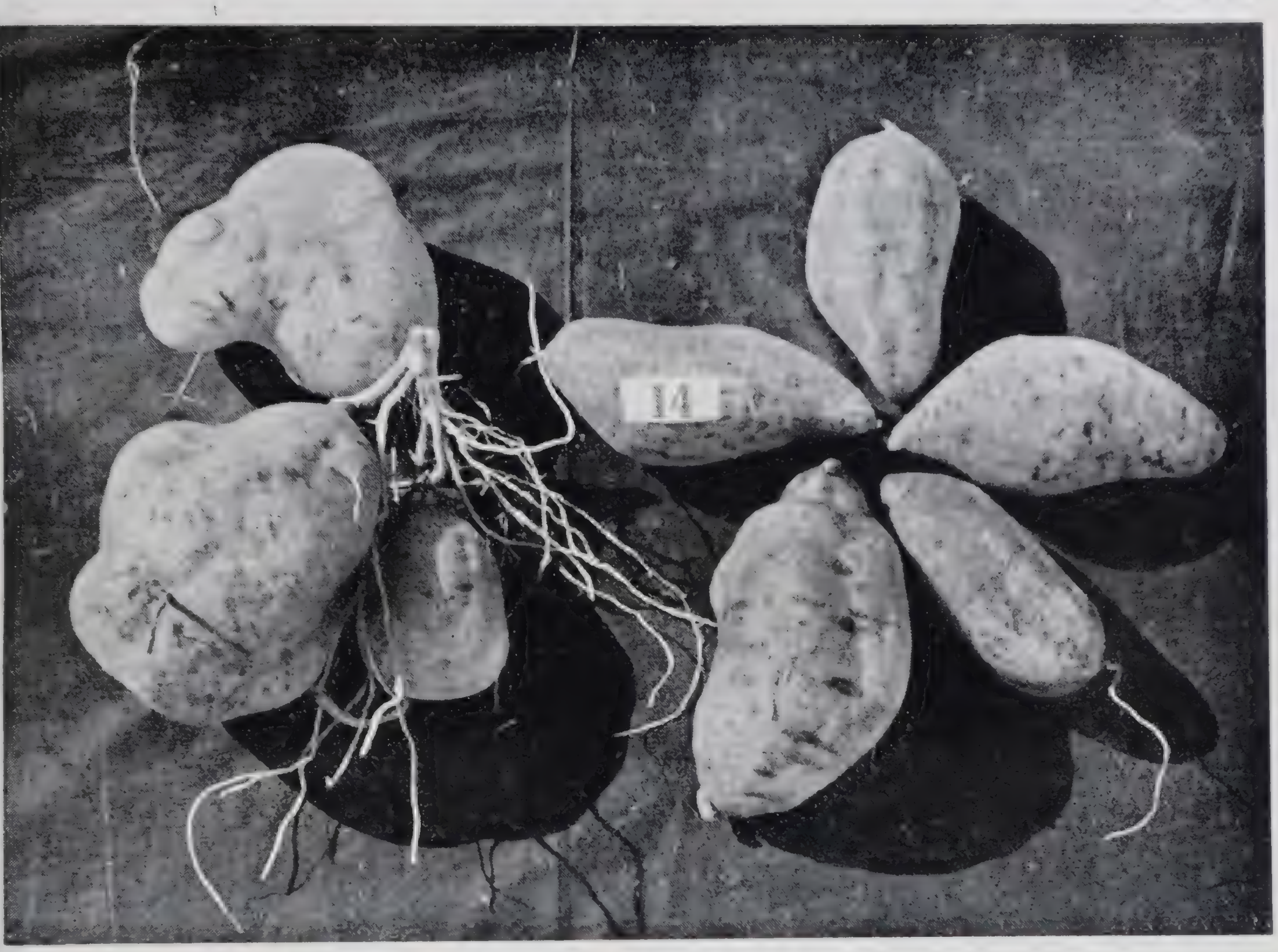
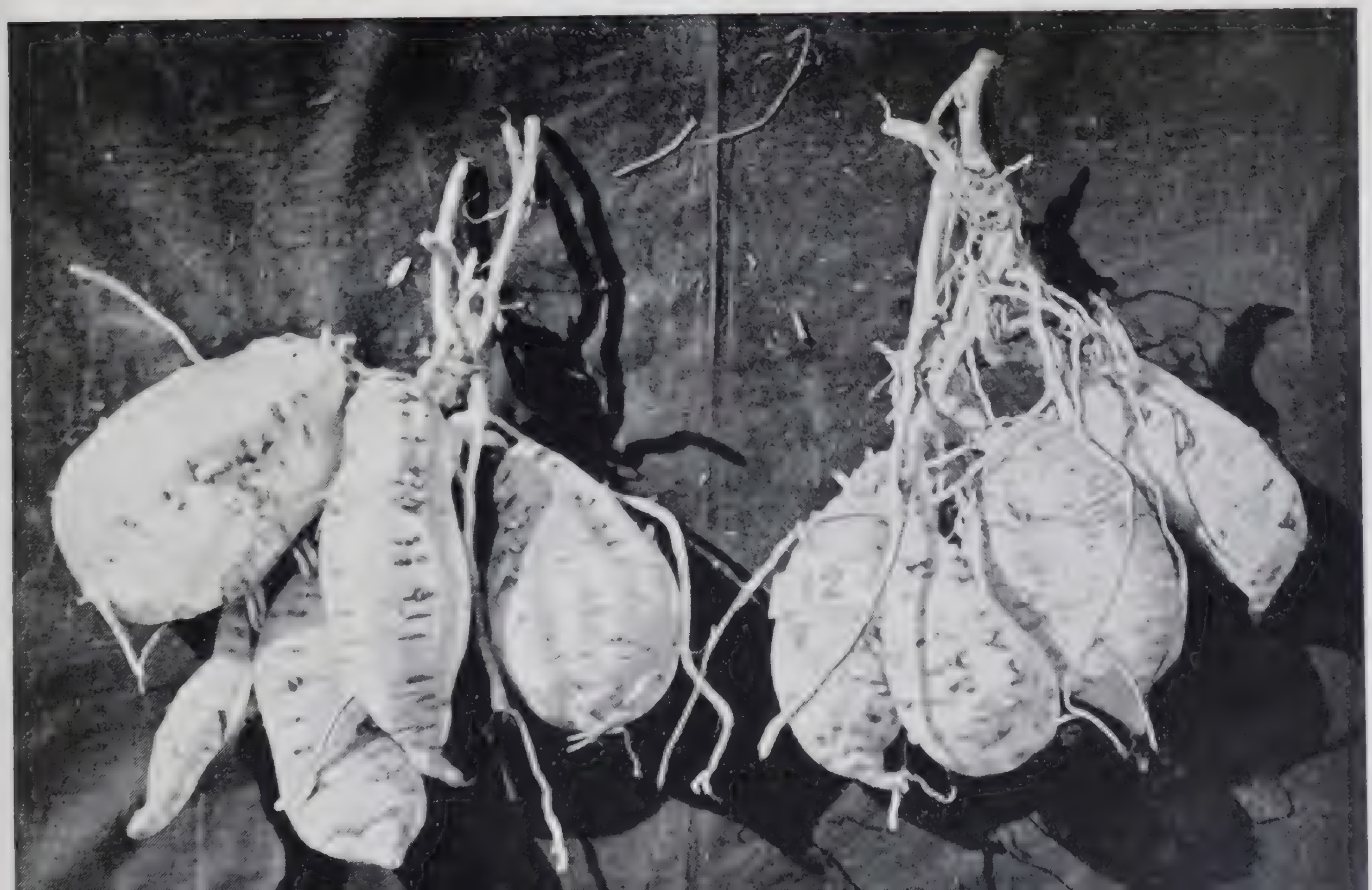


FIG. 1. Sweet Potato, Bengal White—high yielder with highest water content

FIG. 2. Sweet Potato, Pelican Process, U. S. A. strain—starch variety



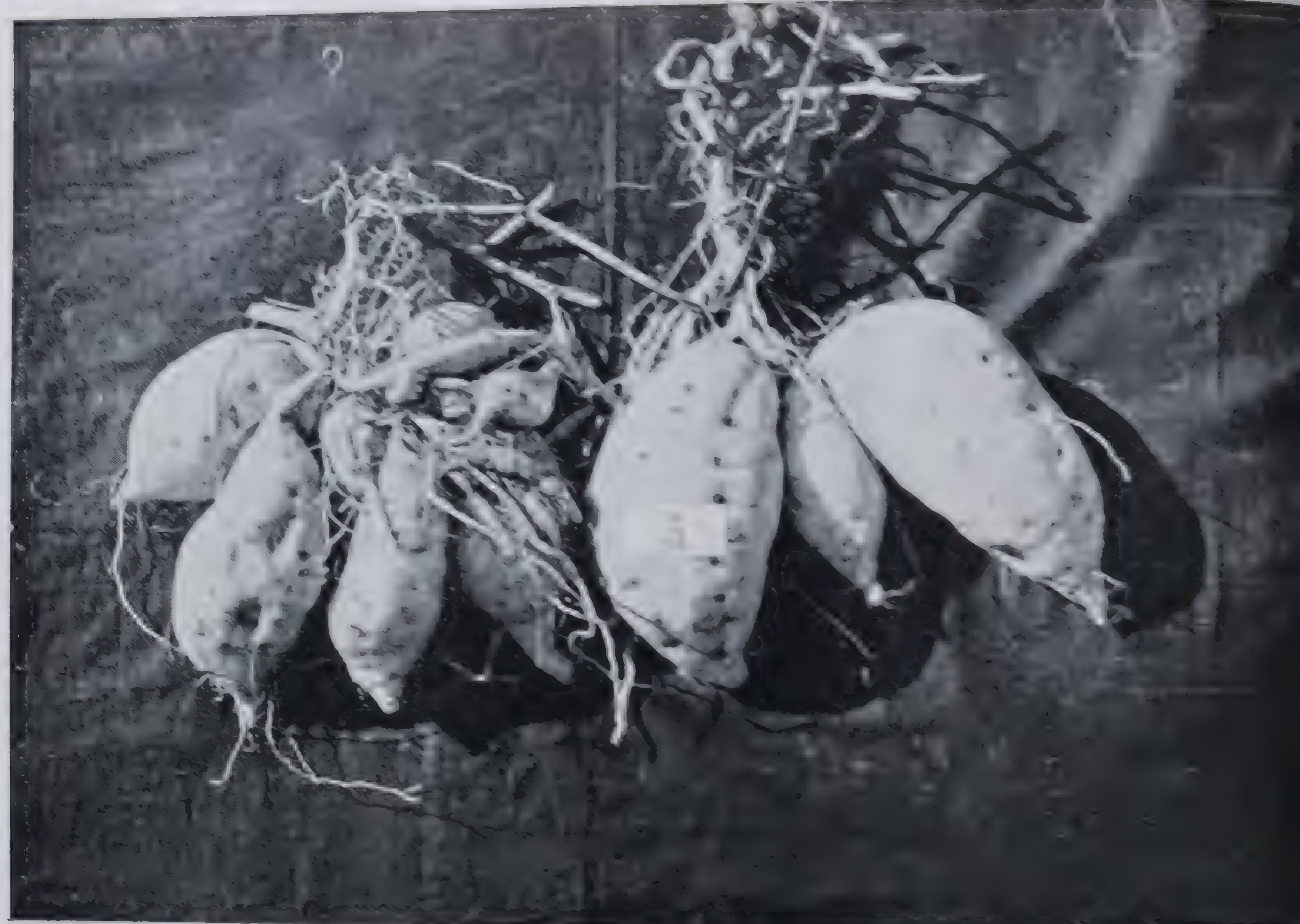
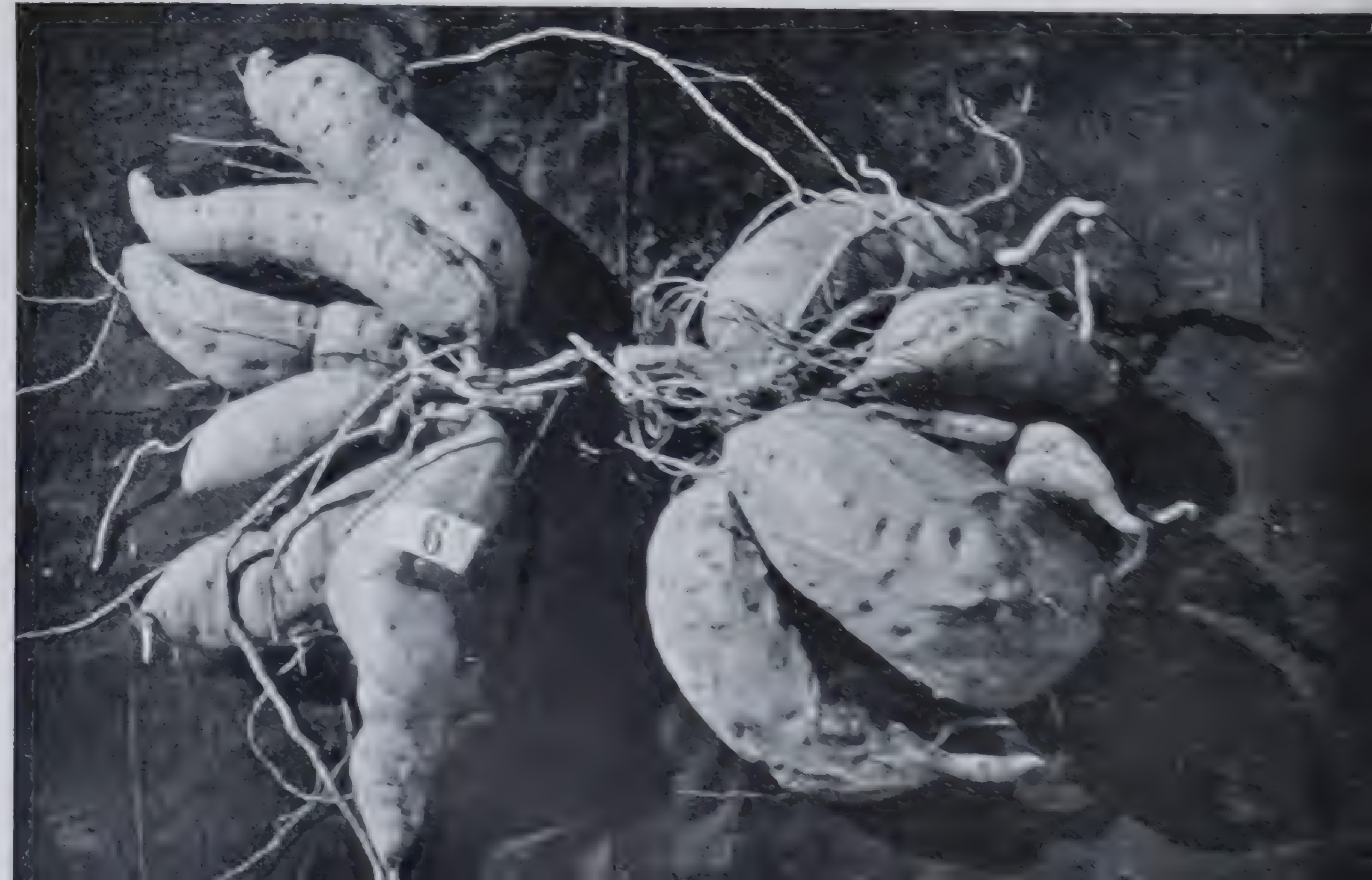


FIG. 3. Sweet Potato, Triumph. U. S. A. [illegible] variety

FIG. 4. Sweet Potato, B-212. U. S. A. [illegible] variety



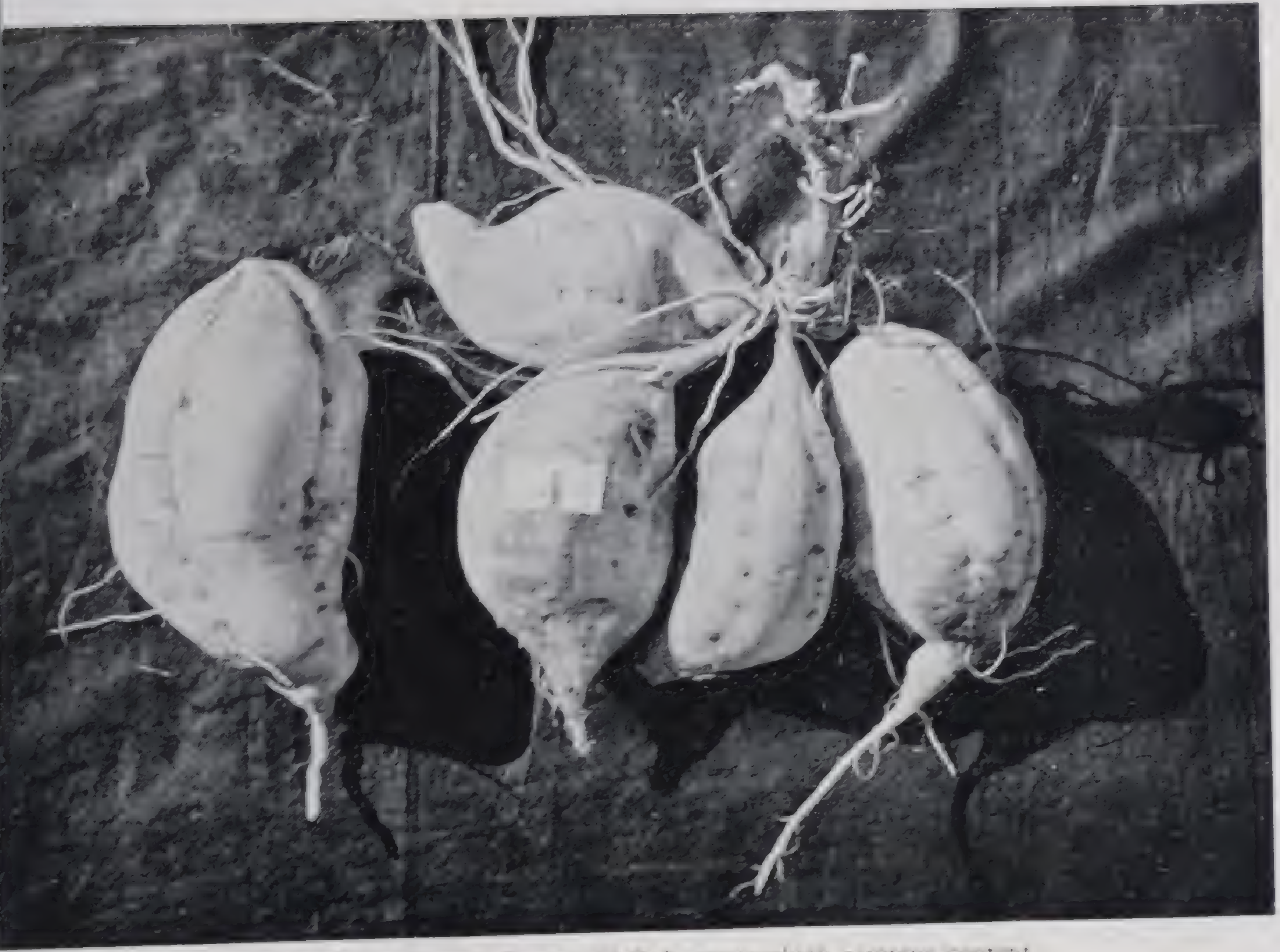
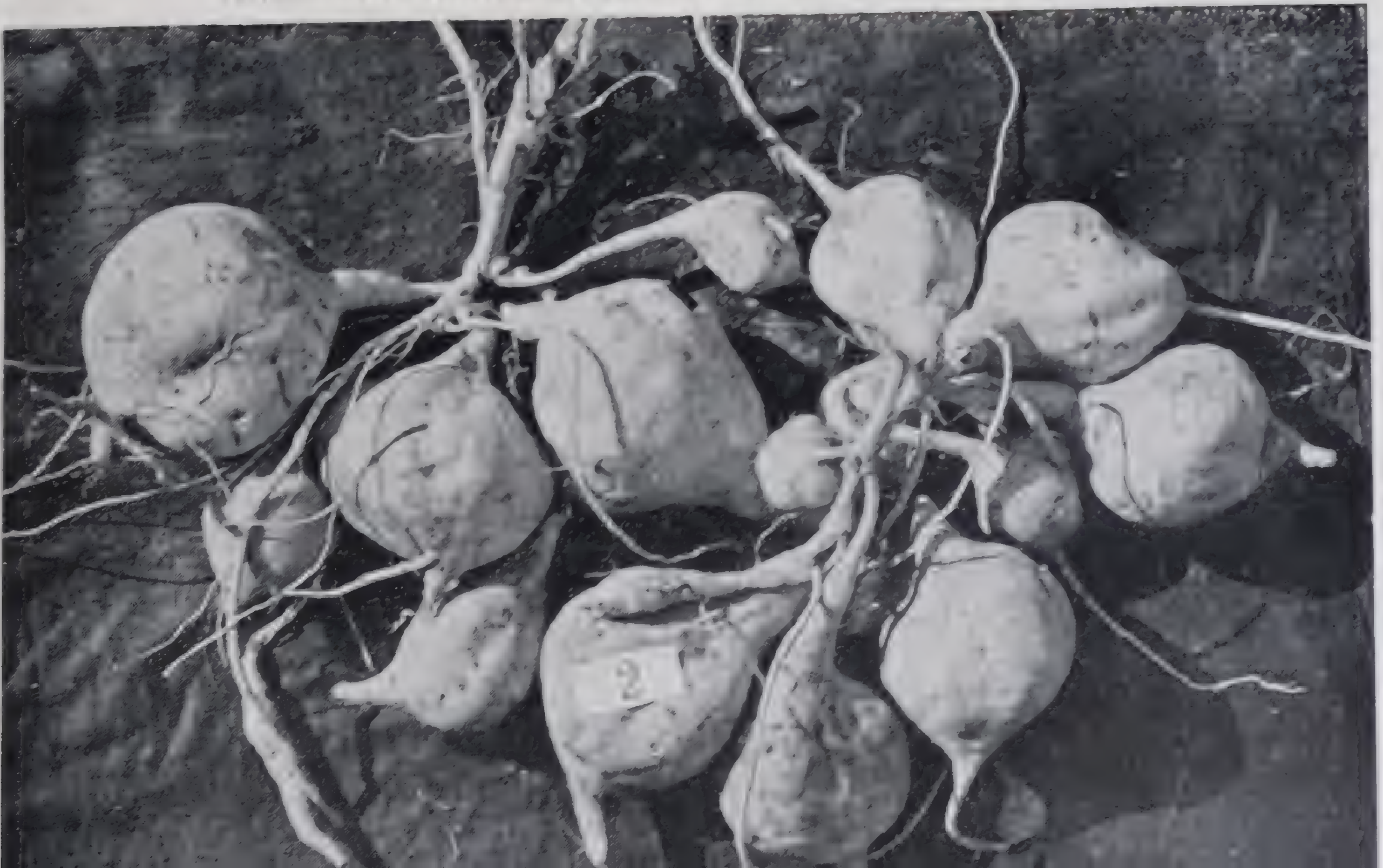


Fig. 5. Sweet Potato, Ranger, U.S.A. strain—high carotene content

Fig. 6. Sweet Potato, Nancy Hall, U.S.A. strain—high carotene content



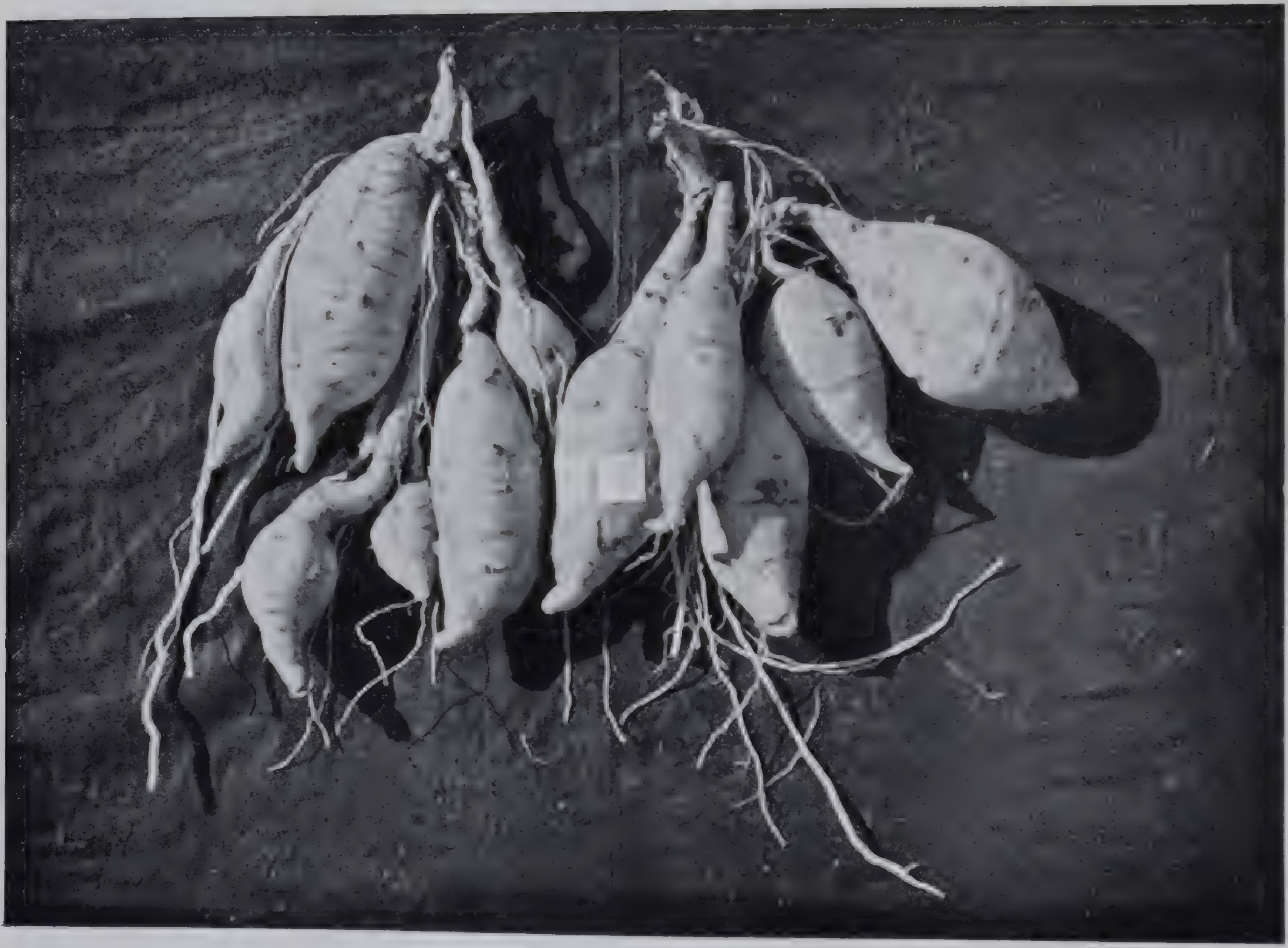


FIG. 7. Sweet Potato, Unit 1, U. S. A. strain—high carotene conten

obtained for comparative trial. On account of the limited area of our experimental plots and the varying number of cuttings of each strain available at any sowing date, a properly replicated experiment could not be undertaken in 1948. Sowings in the experimental plots were continued from 1 May to 26 June, 1948. Each strain was planted in a separate plot—10 ft. × 10 ft. The distance between the rows was 3 ft. and between plants 12 in. For root multiplication, a very late sowing was undertaken on 8 July, 1948 at the U.P. Government Farm at Hawalbagh. The weights of the roots and of the tops (vines and leaves) of each row were recorded at harvest time. From the nature of these two preliminary experiments no conclusive estimate of the comparative yield of the different strains would be justified. But the general claims of sweet potato summarized above seem to be amply justified.

(a) Compared to the yield of the ordinary potato, the yield of sweet potato is much higher. For instance, in a sowing of February, 1948, of several strains of U.S.A. ordinary potatoes, the highest yield, calculated on an acreage basis, was of the order of 220 maunds from the strain Essex. On the other hand, the highest yield of sweet potato was of the order of 435 maunds from the Bengal White variety and 388 maunds from U.S.A. Nancy Hall, as will be seen from Table III. (Photographs of roots of some of the strains are given in Plates 34–37. Obviously, the yield figures given in Table III are not likely to be obtained by the cultivators, until adequate facilities become available for improving their cultural practices. Under similar cultural conditions, however, not only will the yield of the more nutritious sweet potato be higher than that of ordinary potato, but the supply of much needed fodder will be an additional gain.

(b) The fresh weights of the tops of different strains of sweet potatoes as indicated in Table III show that it might even pay us to grow sweet potato on a large scale for fodder alone.

(c) From the records of the yields of roots from rows planted at different dates, it was found that the yields from the first rows of the different strains were invariably higher than those from the latest plantings of the cuttings in the third rows. The yields of Orange Little Stem and of B-4306, planted on 25 June, and of M.4 planted on 6 July, was poor, and yields of all strains planted at Hawalbagh on 8 July were much lower compared to the yields obtained from the earlier sowings in Almora (Table III).

TABLE III

Showing yield, calculated on acreage basis, of roots and tops of different strains of sweet potato observed in Almora and Hawalbagh

Strain	Roots		Tops	
	Almora	Hawalbagh	Almora	Hawalbagh
	Maunds		Maunds	
Unit I	148	121	494	346
Nancy Hall	388	119	180	318
Triumph	347	120	268	166
Ranger	302	112	501	166
B-196	291	208	451	194
B-219	322	82	400	304
B-4004	294	214	440	97
B-4306	79	52	509	581
B-5941	313	...	175	...
Yellow Jersey	235	113	196	137
Jersey Bigstem	289	92	324	28
Pelican Processor	289	...	201	...
Orange Litte Stems	99	...	...	...
Bengal White	436	201	345	180
M.4	126	...	319	...
Bengal Purple	301	...	411	...

To find out the strains best suited for any given region, properly planned coordinated sowings should be undertaken in different regions with all available strains of sweet potato both Indian and foreign. This is essential because the yield and the quality of the produce will depend, under otherwise similar cultural conditions, not only on the strain but also on the climatic factors of the region. From a series of plantings at different dates, the best sowing date for a particular region has to be determined. It will be necessary for each province to establish a central station where chemical analysis of roots can be systematically carried out, to determine the content of carbohydrate, calcium and pro-vitamins. For instance, in Almora the Bengal White variety gave the highest yield, while in Hawalbagh the U.S.A. strains, B-4004 and B-196, both gave higher yields than Bengal White. On the other hand, we found that the moisture content of roots of Bengal White was very high, about 83 per cent, while that of Nancy Hall was 69 per cent and of Triumph, 63 per cent. Computed on the basis of solids, the yield of Bengal White was 74·46 maunds compared to 120·28 maunds for Nancy Hall and 128 maunds for Triumph per acre.

Along with agronomical studies, there should be a comprehensive research programme for breeding still better strains of sweet potatoes suited to Indian climatic conditions. In the U.S.A. most of the improvements of sweet potato have been confined to the selection and propagation of the outstanding mutations, since most of the sweet potatoes do not normally flower in the U.S.A. climate. By overwintering and girdling, Dr Miller has been able to carry out his programme of sweet potato breeding. In India, we are likely to find areas where the different strains of sweet potatoes would normally flower and thus facilitate the breeding work.

In view of our shortage of both food and fodder, we should not be taking any risks in intensifying the cultivation of sweet potato all over the country during the coming year. Furthermore, sweet potato grows extremely well in newly reclaimed land, and therefore in our vast reclamation programme its cultivation should be given the emphasis it deserves.

It is a pleasure to acknowledge the enthusiasm and help of all members of the staff in our first work with sweet potatoes at this Laboratory, particularly of Shri Tara Datt Pant in the supervision of the field work and of Shri Shankar Lal Sah, in the despatch of over 32,000 vine cuttings sent on request to the different Provinces. The financial aid received from Shri Charat Ram, New Delhi, has enabled me to meet the expenses of this preliminary work with sweet potato.

Note: The sizes of the different strains of sweet potatoes reproduced in the plates are strictly comparable.

VEGETABLE SEED PRODUCTION IN THE KULU VALLEY

By SWARN SINGH PUREWAL

ONE of the primary requisites for success in vegetable growing is the use of good seed and for increasing the production of vegetables the most essential thing is a dependable source of seed supply. In the past in the absence of organized vegetable seed breeding stations and seed control laws in this country, the seed supply could not be altogether regulated. Unless and until vegetable seed production is planned and organized on a scientific basis, vegetable growing, and especially increased production, cannot be placed on a sound footing. In the matter of imported seeds, however, this country was afforded a golden opportunity during the World War II to develop its own seed industry when due to transportation and other difficulties, the imports of seeds became altogether impossible. The Agricultural Production Adviser and his staff in the Ministry of Agriculture, Government of India, seized this opportunity and did much to organize seed production in Quetta and Kashmir, but as a result of partition, Quetta is no longer in the Indian Union and in Kashmir, the production has been totally dislocated as a result of disturbances. At the present time, therefore, we are faced with the difficulty of finding alternative sites and utilizing these for vegetable seed production.

For the successful production of seeds of European varieties of vegetables such as cabbage, turnip, etc. the root cuttings or mature plants, as the case may be, after transplanting are required to be exposed to a low temperature of 40°F. or lower for a period of one month or more (January-February) coupled with dry and cool conditions at transplanting time (November-December), warm and dry season at harvest time (May-June) and moist and comparatively cool climate during the growing period (July-October). Requisite climatic conditions for the production of these seeds obtain in the Kulu valley which can be seen by reference to the meteorological data in Table I collected at Katrain.

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TABLE I

Averages of meteorological data for the last three years (1945-47) *recorded at Katrain*

Month	Maximum temperature °F.	Minimum temperature °F.	Rainfall in.	Remarks
January	51·6	33·3	3·2	
February	58·6	36·3	2·6	
March	64·6	43·3	5·6	
April	77·6	47·3	2·6	
May	83·3	53·3	2·2	
June	87·0	59·6	2·9	
July	84·3	65·0	6·2	
August	82·0	69·0	6·8	
September	77·0	62·0	8·7	
October	72·2	46·3	2·4	
November	65·0	38·6	0·5	Rainfall in 1946 only.
December	54·3	43·0	3·0	
			45·5	

At the instance of the Indian Council of Agricultural Research, New Delhi, and realizing the need of the time, the writer in 1942, when European imports of seeds were impossible, started the work of vegetable seed production at Katrain (Kulu valley) at an altitude of about 4,800 ft.

The first two seasons were spent on experiments for ascertaining the optimum time of sowing these crops for seed production and in the development of proper technique of combating insect pests, harvesting and curing of seeds. Now for the last four years these seeds have been commercially grown on our farms with considerable economic returns and for meeting the needs of the growers in the plains of the Punjab. As a result of changed conditions, the Kulu valley has assumed great importance for seed production work. It is, therefore, deemed desirable to publish such information as is available on the subject to serve as a practical guide to those who want to take up commercial seed production there.

Methods of production

Seed production is an exacting work, which requires technical knowledge of plant breeding and of growing of seed crops, of curing and handling seed and of prevention of crossing in the field. For the production of pure seeds, the selection of suitable stocks and isolation of the seed plots to prevent crossing is the most important. Some of the vegetable crops such as peas and beans are normally self-pollinated and their different varieties may be grown close together without any danger of crossing. Others such as cabbage, cauliflower, kohl-rabi, turnip, radish, beet, etc. are cross-pollinated and their varieties and closely related species need to be segregated. The crops belonging to the *Brassica* group readily cross with each other if they happen to be in blossom at the same time. Therefore, for the production of seed, these need to be completely isolated if several of the varieties are to be grown or if several of the Brassicas are to be grown. The distances necessary to separate varieties depend on the mode of pollination, i.e. whether it is effected by wind or insects.

In case sufficient land is not available, the difficulty may be overcome by growing not more than one variety of any of these crops at one place. In the Kulu valley, the writer had found the solution of the problem by utilizing plots with a distance of two or three miles between them. Of course, there was the advantage that nobody else was growing these crops there for the purpose of seed production thus precluding any chances of cross-fertilization.

The soil of the Kulu valley especially in Behal (along the River bed) is rather poor. Therefore, for obtaining good yields, it is necessary to manure the soil copiously with farm-yard manure. The minimum quantities of manure to be applied should not be less than 600 maunds per acre. Ample use of ammonium sulphate is also desirable when the plants are growing vegetatively, as well as at the time when stalk formation starts, i.e. in spring when new growth takes place. At least three maunds of ammonium sulphate should be applied in two dozes when the crop is growing vegetatively and another maund or so in spring at the time of the seed stalk-formation; the latter makes the seed plump. Seed crop production is not possible under *barani* (rain fed) conditions and should not be attempted.

Cabbage

The seed is sown in the seed bed for the production of seedlings from the fourth week of June to the middle of July; half a pound of seed is sown to produce seedlings for one acre. The seedlings are ready for transplanting in three to four weeks after sowing. The plants are transplanted in rows 1½ ft. apart and plants 18 in. asunder. They are grown in the fields till the end of November with regular cultural operations. In November, when the plants are full-grown, every other row is removed and the desirable plants from the uprooted ones are used for filling in the gaps resulting from mortality and roguing operations in the remaining rows. The good plants surplus to the need may be transplanted in a separate plot. Roguing is very essential for the removal of the off-type plants as well as those forming loose heads. Finally, the distance between the rows of plants is 3 ft. The plants are earthed up in December to cover the stems before it starts snowing during January-February. In March the sprouting begins which is indicated by the early bulging of the heads. To facilitate sprouting, a cross-wise cut is given to each head taking care that the sprout is not injured. This cut helps the sprouts in coming out quickly, straight and in the centre; otherwise sometimes the sprouts come out on the side and grow on the ground or fall on the side. As soon as the sprouting begins by the onset of warm weather, the insect fauna also become active. The aphids make their appearance earliest, followed by cabbage butterfly. The aphids are the most harmful of all the insects because they suck away juice of the pods and flowers causing them to wither. The aphids are controlled by spraying with 2 to 3 per cent soap solution or with tobacco decoction. Also hand-picking of insects sometimes is very essential; yellow clusters of butterfly eggs are easily detectable and picked off by hand. Insects must be controlled constantly till the maturity of the pods. As the pods begin to ripen, the side shoots usually fall on the ground because of the weight of the pods. In order to save the pods from damage due to falling, the side shoots are generally held up by means of stretching strings along the rows and tying the strings at the ends of the rows to stakes. If the rows are too long a few stakes are also driven in at intervals; this also prevents breaking of the strings. It is better, if the string is wound round two or three plants together here and there along the row; this keeps the plants fastened in the event of heavy winds.

Harvesting starts by the beginning of June. Early-ripened pods are detached by sickles from the parent plants lest they should be shattered. The whole field is thus covered to remove the early-ripening pods. As the green pods ripen, they are again removed and thrashed after two to three days. The main stem is left standing in the field and removed afterwards and burnt. The harvesting is completed by the middle of July. The average yield per acre is 200 lb.

Rotting of the heads takes place during spring due to soft rot. Therefore, provision for proper stand should be made by making thick plantings. Soft rot is a deadly fungal disease of young as well as head-stage plants and the plants affected should be removed immediately.

Turnip

The turnip seed at the rate of 2 lb. per acre is sown on the ridges 1½ ft. apart in the field for the production of roots from the second week to the end of August. The seed germinates three to four days after sowing. The thinning of the plants is done from time to time beginning after three weeks of sowing; the final distance from plant to plant should be 6 to 9 in. The roots are ready for transplanting by the beginning of November when they are dug out and typical healthy roots are selected for transplanting. The root cuttings are prepared by removing about one-third of the lower portion and trimming the leaves about 1 in. in length from the crown end. The root cuttings are planted in a well prepared field in rows 2 ft. apart and the plants in rows 1½ ft. to 2 ft. apart. The root cuttings are buried in the soil up to the crown end and as the seed stalks grow out, the plants are earthed up resulting in small ridges. No staking of the plants is done in this case.

The crop is ready for harvesting by the middle of May. As the pods ripen, the stalks are removed by sickles. The entire crop is removed by going over twice. The stalks after cutting are stored for two or three days and then thrashed by beating out the seed. The average yield per acre is about 180 to 200 lb.

The turnip is affected by root-rot disease which starts at the time of the formation of knobs and continues even in the transplanted roots, causing gaps in the raws. Some spare roots are usually kept to fill the gaps occurring shortly after transplanting say till the end of January.

The crop is heavily attacked by aphids and cabbage butterfly. The same control measures are practised as in the case of cabbage.

Some sort of malformation of the plants also occurs at the time of flowering as a result of which the plant remains altogether barren or partially barren. This causes considerable reduction in the yield. All the varieties are equally affected by this disease.

Kohl-rabi

The seed is sown in the nursery beds in the month of August and the transplanting of the seedlings is done by the middle of September in rows 2½ ft. apart, and the plants in rows 18 in. asunder. Regular cultural operations are performed and when the knobs begin to enlarge slight earthing up is done and off-type plants are rogued out. The seed stalks begin to emerge in the month of March as soon as the season warms up. Insect pests attack flower shoots and the most prominent ones are aphids and cabbage butterfly in the early stage and *Begrada picta* in the last stage of plant growth.

Aphids are controlled by spraying with soap solution with a small quantity of kerosene oil added to it. Cabbage butterfly lays eggs mostly on the leaves in clusters and which very conspicuous and are picked by hand and destroyed. D.D.T. 0·1 per cent spray in water kills the young larvae that emerge out of the unpicked eggs. *Begrada picta* attack is not very common nor regular. It appears only when the winter is dry and the summer sets in earlier. The seed is ready for harvesting by about the middle of May, when the plants are cut and stacked in heaps to allow the unmatured seed to ripen up. Then the seed is thrashed on a canvas or on a dung-mud plastered floor. The average yield is about 400 lb. per acre.

Carrot

The seed is sown in the middle of July in the field on well-prepared ridges at the rate of two to three seers per acre. The germination is usually poor and re-sowing has to be resorted to. Plants are thinned so that they are 2 to 3 ft. apart when they are about 2 in. tall. The roots are dug out and the shapely, healthy ones are selected for the preparation of root cuttings. Care is taken that only well-matured roots are selected for transplanting. Immature roots take longer to start sprouting and consequently delay harvesting. The roots are transplanted during the month of December. The root cuttings are prepared by removing about two-thirds of the lower portion of the root and by removing the leaves 1 in. from the crown end. The roots are transplanted on the flat in rows 2½ ft. apart and the plants 2 ft. asunder. One acre of the crop will approximately produce roots for sowing five acres, but in the case of turnip this ratio is 1 to 4 or even 1 to 3 if the distance of trunip roots from plant to plant is reduced.

The sprouting of the roots starts in the beginning of April when the roots are earthed up and flowering begins towards the end of April. In the case of cabbage and turnip sprouting begins towards the end of February and beginning of March, when the weather warms and the flowering starts by the end of March or in April. In the case of carrot, the flowering continues till rains set in. The early flowers start ripening in the beginning of July and the entire harvesting is completed by the end of the month.

The ripened umbels are cut by sickles and gathered in baskets (*kiltas*) and are sun-dried for three to four days depending on the weather. The entire field is gone over two to three times for completing the harvest. As the harvesting of this crop is done in July, considerable difficulty is experienced in thrashing it because of the rainy weather. The wet weather also imparts dirty colour to the seed. The average yield per acre is about 200 lb.

The carrot is comparatively free from the attacks of insects and fungal disease, but its roots are affected to some extent by root-rot after they have been transplanted and also when the shoots are in flowering stage.

Beet root

The beet sets seed easily at Katrain and is usually the healthiest of crops. Like carrot, the crop is slow in growth and late in ripening. The seed is sown on well-prepared ridges in the month of July at the rate of six seers per acre. The plants are thinned 3 to 4 in. apart when about 2 in. tall. The plants are ready for transplanting in November when the root cuttings are prepared in the same manner as turnip by cutting off one-third portion from the bottom and by trimming the leaves 1 in. high at the crown end. Rigid selection is made when preparing the root cuttings, keeping only the true-to-type roots for transplanting. Solid coloured roots and roots altogether lacking white streaks or rings should be selected for transplanting.

The cuttings should be planted in rows 2½ ft. apart and plants 1½ ft. asunder in rows. The transplanting should be completed in the month of November so that the root cuttings would take root before the onset of the cold weather. The plants should be slightly earthed up in December before it begins to snow.

In spring, in the month of March, seed stalks emerge and flowering starts in April. The crop is ready for harvest in July. When the seed has ripened, the stalks are cut and allowed to dry for three to four days after which the seed is thrashed. The average yield is 575 lb. per acre.

Dwarf or French beans

This is one of the normally self-pollinated crops and its seed can be produced without much difficulty. The different varieties of this crop may be grown close together for seed without danger of crossing.

The crop may be sown in a well-prepared soil in April when the season has warmed up, as the optimum temperature for the germination of the bean seed is about 75°F. The seed may be sown on ridges or in rows on the flat 1½ ft. apart. The seeds should be sown two to three inches apart and one inch deep, taking about 30 to 40 seers of seed to plant an acre.

After the crop has germinated, any gaps that may occur as a result of poor germination or depredations of the earth worms, which sometimes become very serious, may be filled in. Regular cultural attention should be given to the crop so that the growth is not hampered. When the plants have flowered and are forming pods, the off-type plants should be rogued out.

The crop is ready for harvesting in August, when the plants are cut and removed to the thrashing floor. The seed is beaten out. The average yield per acre is about 500 lb.

POOL PRICES OF SUPER-PHOSPHATES

SUPER-PHOSPHATES produced in India will now be available at a pool price of Rs. 227 per ton to provinces and States, according to a decision taken by the Central Ministry of Agriculture in pursuance of the recommendations of the Indian Tariff Board fixing fair ex-works prices of super-phosphates.

Super-phosphate is a chemical fertilizer useful for maintaining soil balance and stimulating plant growth. In India there are certain areas which are naturally deficient in phosphates; viz. the Madras Presidency, Mysore, Travancore, North Bihar and parts of the C.P. and Bombay. A judicious application of super-phosphates coupled with nitrogenous manures can add to the soil fertility considerably and increase production in these areas.

At present, a number of factories in India, situated in Travancore, Mysore, Madras, Hyderabad, Bombay, Ahmedabad and Delhi are producing super-phosphates. The entire production in the country is taken over by the Central Phosphatic Pool, maintained by the Central Ministry of Agriculture, and then distributed to the provinces and States, according to their requirements at a certain fixed price.

Taking into consideration the total production from all factories in India, the Ministry of Agriculture have now fixed Rs. 227 per ton f.o.r. despatching stations as the pool price for supply of super-phosphates to the provinces and States. The price will remain operative up to the end of this year.—***P.I.B.***

SUGGESTIONS FOR AGRICULTURAL DEVELOPMENT IN INDIA

By S. RANBIR SINGH

AGRICULTURE is the primary industry of India. Most of our industries moreover depend directly on agriculture, e.g. textiles, sugar and alcohol, oil pressing and soap, leather and jute, etc. so that at the final computation agriculture maintains about 90 per cent of our workers. Agriculture can, therefore, be looked upon as the chief industry of India and the development of agriculture is the foremost problem before the country.

Before the war India with Burma was a food exporting country. During the last phases of war India faced food shortage, specially at the Burma War front (Bengal famine). Various factors, following in quick succession, culminating in the creation of Pakistan, have left India not only bleeding but perhaps seriously disabled, so that a number of experts believe that immediate steps shall have to be taken to avert a possible tragedy.

A 'grow more food' campaign was started by the then Government about five years ago. The propaganda was vigorously taken up by the press, the platform and on the air. There were several conferences of the Central and Provincial Departments of Agriculture. But the campaign did not seem to have achieved remarkable results. In 1947 a vital change was effected and the Government has passed into the hands of Indians. The steps that have been taken by the new Government are more practical, e.g. the ploughing up of Ganga Khadar, but the problem is an extensive one. The Multiple Purpose Projects, many of which are now engaging the Government's active attention, will provide the much needed irrigation and solve the power problem to some extent. Still the steps taken so far in the interest of the 'grow more food' campaign are more or less temporary and leave the crux of the problem practically untouched and the danger is that as long as no permanent solution is found the evil day is merely put off. And who knows what formidable proportions the evil might assume and what unforeseen calamities the future may have in store for us; floods, drought, failure of monsoon, war, remain unpredictable. It is, therefore, necessary that the earlier we adopt the remedial measures, the better our chances of success.

There is another drawback of procrastination and that is the enormous loss of buying power—millions of dollars that are now spent in buying foodgrains from foreign countries. This provides an additional reason why effective measures should be adopted before there is an actual breakdown.

The suggested measures

For successful agriculture there are two important factors: (i) the land and (ii) man to manage it.

It is universally accepted that our soil is on the whole good if not rich, but it is also universally admitted that it is badly managed. The remedies, therefore, should be considered from these two angles. We shall consider the soil first.

Our greatest danger as far as soil is concerned is erosion—not only the scouring from high winds and floods but the slow yet sure displacement of rich surface soil by moderate local rain. For example it has been estimated that about eight tons of soil per acre is displaced by 3 in. of rain in a field having a slope of 1 in. in 100 ft. Such a slope can hardly be noticed. Of course the losses are far greater with steeper slopes. The remedy for large fields is now well known; the requirement is only a tractor equipped with a grader.

Most of our waste lands are uncultivable:

(i) because they are uneven or too rough for the bullock plough or too full of weeds; or

(ii) because they are unirrigated.

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The long range solution of irrigation is sought to be found in the various big projects that are being taken up by the Government but an interim remedy well worth considering is the supply of water from the wells worked by oil engines. This solution is beyond the means of average ryots except on a cooperative basis but again Government lead is necessary to get things going. As an alternative Government can sink tube-wells and charge water rates.

The only practical way to bring the rough or uneven plots of land under the plough is to have, say, two tractors with necessary equipments for each district on the basis of an acceptable rate of payment which may be deferred in certain cases. The same tractors can look after grading too. The payment can cover either the maintenance of the machines and the personnel or the original cost of the equipment; in the latter case the machines may be passed on to cooperative ownership, the Government maintaining the staff.

As an alternative the machines can be cooperatively owned and may be employed for reaping and thrashing for extra income. Still the Government shall have to take the initiative by collecting the price along with the revenue or in some alternative way of equal simplicity.

Management

Our second problem, the man, is a much harder problem to tackle for the following rasons:

The cultivator (whether a landlord or a landless labourer) has gone on without education for centuries. The igorance has grown for untold generations till it has assumed colossal proportions. Although recent upheavals and the political awakening in the country has affected most persons, the farmer plods on stolidly in his former conservatism, unconcerned by the changes around him. As a result his sense of values is rather distorted and Government help, unless tactfully given, might be looked upon with suspicion.

The only permanent remedy of such appalling ignorance is to educate the coming generations in order to break the farmers' conservative nature. The problem of education is far from simple. The existing school is not only unsuitable, but it produces pernicious anti-agricultural trends. The need today is to evolve a new system in which the teaching is centred round agriculture and agricultural operations, the medium of instruction being the mother tongue.

To make the scheme practicable four or five villages should be organized into a unit with its own school, demonstration farm, independent water supply and a well-planned course of instruction and practical work in agriculture, in which the three R's have been well integerated. There should be compulsory attendance for all children of the unit between the ages 6 to 12 years.

Moreover, agriculture should be made a compulsory subject for secondary school (rural or urban). Reading courses should accentuate the importance of agriculture to the individual, to the worker and to the society. They should point out the phenomena of growth, the multiplication of seed, the balance of nature (give and take between animal and plant), what man-made selection has achieved, how new varieties are evolved by crossing, the importance of fruit growing and why cutting and budding are possible. The aim should be to make the new generation agriculture-minded; agriculture may with advantage be made an elective subject in all colleges.

The greatest problem of management is labour. Our farm labour is positively dishonest. With the landlord who works with the labourers, the output per head is roughly four times as much as that of the labourer working without supervision. Steps must be taken to see that the next generation has a greater sense of honesty, duty and responsibility. Young men must be awakened to the realization that they owe it to their country, their society and to themselves to be hardworking and trustworthy.

Village officials

Our food situation is so critical that the present day methods can hardly be relied upon. We cannot wait for the next generation to take over. It is of no use trying to make the ryot literate. The experiment has glaringly failed many times. The training of the adult should take the form of oral instruction with frequent demonstrations. It has been experienced that the persons wielding influence over the villager have always evinced a hostile or at least suspicious attitude towards all new fangled ideas, particularly those advocated by the Agriculture Departments. For more successful results it is necessary to get the cooperation and help of all such persons as the *patwari*, the *lambardar*, the *zaildar*, etc. It is suggested that for an effective execution of this programme these village officials be given a short term training in the use of modern labour-saving devices and improved practices, so that they should be in a position to back up the programme not only with their moral support, but with conviction born of experience. The future recruitment of all village officials should be made conditional on their having undergone such a course of training in modern agriculture.

Moreover, to improve the present position of agriculture it is necessary that every village should have a set of bullock-driven labour-saving implements and all kinds of improved seeds. These would facilitate demonstrations and would induce people to go in for them for use on their own land, it being understood that such implements and seeds would be easily available. This would result in better preparation of seed-beds followed by better crops, resulting in higher yield per unit area. This will go a long way to ease our present position of food supply.

For greater advantage the school building can also be used as a centre for teaching and organizing village crafts, for village uplift work, for revival of village games, for radio installation, for visual demonstrations with slides and picture films.

LAND RECLAMATION IN THE CENTRAL PROVINCES

THE Central Tractor Organization of the Ministry of Agriculture is operating 96 tractors for reclamation purposes in the Central Provinces and Berar during the current season. The work is being done on a ' no-profit no-loss ' basis. The tractors used in the Central Provinces are rehabilitated tractors taken over from the Disposals Directorate. Each tractor can reclaim approximately 0·5 acre per hour. A total area of 12,716 acres was reclaimed up to 21 March, 1949. During the current season a total area of 60,000 acres is proposed to be reclaimed.

The total area of weed-infested land in the Central Provinces, requiring reclamation operations in 6,00,000 acres. It is proposed to reclaim the entire area within a period of seven years under another scheme, which is at present under the consideration of the Government of India.—*Food Bulletin*, April 4, 1949.

TRAINING MIDDLE-CLASS FAMILIES IN PRACTICAL AGRICULTURE

By DEBENDRA NATH MITRA

THERE is a large number of young men belonging to the middle and lower middle class families living in the countryside and doing miscellaneous items of work to maintain themselves. They possess a little education, say up to the matriculation standard. Among their items of work there is some form of agriculture. I know of instances where young men possessing small shops are looking after cultivation of crops, in right earnest, on small areas of land of their own: there are instances also where many young men employed in business establishments on a monthly salary have been rearing ducks, goats, hens, etc. with zeal and enthusiasm. Growing of fruits and vegetables has been undertaken by almost all in addition to their usual employment. And there is also the rearing of fish in many cases. But every item of work is being carried on according to time-worn methods as they do not possess any knowledge of modern developments of any of the subjects. The local cultivators, fishermen and such other people are their guides. Many of them may be willing to take advantage of a practical training in the improved methods regarding these subjects. They have, however, no means to pay for such a training. Nonetheless this training will go a long way to augment their income and in addition assist very greatly in the introduction of improved methods in the countryside.

There are also many young men with more or less similar education living in the countryside and ekeing out their existence anyhow; they are desirous of adopting agriculture or any branch of it as a profession if facilities in the shape of land and money are extended to them. They are also unable to meet the expenses of their training prior to the adoption of this useful occupation.

A scheme may perhaps be prepared to afford facilities of training to both the classes of young men mentioned above and to encourage the latter to take to agriculture as an useful occupation on small areas of land in the rural areas. A scheme may perhaps be prepared on the basis of the scheme worked out by me at the Government Agricultural Farm, Faridpur (now in Eastern Pakistan) to settle members of middle-class families with *khasmahal* lands after a year's practical training in agriculture. The training did not cost the trainees very much nor was the Goverment involved in much expenditure on this account.

The scheme of training may be briefly stated. It provided one year's training in practical agriculture at the Government Agricultural Farm, Faridpur, with instructions in agricultural carpentry, elementary veterinary practice, and principles of co-operative credit. During the period of training the youths were required to work at the farm as labourers and were paid Rs. 12 a month each for their labour on the farm to enable them to meet the expenses of their food. They were given free accommodation on the farm but were required to bring their own utensils, bedding, lights, etc. and to arrange for their own meals. After the year's training each youth received provisional settlement of a 15-*bigha* plot of *khasmahal* land free of rent for three years and was advanced Rs. 200 by Government under Land Improvement or Agricultural Loans Act for initial expenses. These advances were made on the personal, joint and several security of two persons acceptable to the Collector. The advance with the usual interest was recoverable in four annual instalments commencing from the seond year after the money was advanced. There was a further condition that if for any reason the provisional settlement was terminated by the Collector at any time, the whole amount or such balance as was outstanding would be immediately recoverable from the two sureties. Having

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been given the land and the loan each youth was required to bring the land into cultivation on his own and was not allowed to let out the land on *barga* settlement nor in any other way sublet the land or any portion of it. At the end of the three years, provided satisfactory progress was made, an ordinary *raiwatari* settlement was made on the usual terms obtaining in the Government Estate in which the land was situated; no *salami* was charged. There was also a provision in the scheme for the settlement of more land at the Collector's discretion up to the limit which could be cultivated by each youth and his family. The work done on the land would be inspected twice every year by the District Agricultural Officer and the *khasmahal* Officer and the Collector would decide on their reports whether the arrangement should continue.

According to the above scheme the first batch of five boys was taken for training in March, 1928. It continued for six or seven years. The youths after training showed considerable energy and enthusiasm in their work and laboured hard to make their venture successful. They lived in *kutcha* sheds in far-off *char* lands in the midst of the cultivators and, like the cultivators, did all the operation with their own hands and even cut jute in knee-deep water. They used to cook their own food. On the whole, they set an example of the dignity of labour. But unfortunately they were not provided with suitable lands. In almost all the cases newly formed *char* lands were given to them which used to go under water during the rains and the water remained on the lands too late to grow any *rabi* crops on them. The only crops they could grow were deep-water paddy and jute. Moreover, being far away from the town and having no cheap transport facilities they could not market their produce like winter vegetables, tobacco, groundnut, etc. easily and profitably. In one area the youths grew groundnut but having no local market for it they had to bring it in a country boat to the nearest town, a distance of about 20 miles. And the cost of transport was very heavy causing them considerable loss. The success of a venture like this depends chiefly on suitable lands capable of producing two or more crops and upon the proximity to towns with easy transport facilities.

The scheme however attracted notice of many provinces and enquiries came from many quarters. It also received blessings and encouragement from many eminent persons. The late Sir P. C. Ray contributed an article about it to the *Modern Review* in April, 1929, under the caption 'Dignity of labour taught at the Government Farm, Faridpur'. The Revd. W. S. Urquhart, the then Vice-Chancellor of the Calcutta University, said thus in course of his presidential address at the Faridpur Agricultural and Industrial Exhibition, 1930: 'There is connected with it a scheme for the education of members of middle-class families in such a way that they will be able in a comparatively short period to support both themselves and their families honourably and comfortably. I was greatly impressed this morning visiting the small colony of these young men who are doing work here, to see how vigorously they were throwing themselves into the work and how happily they seemed to live together in this useful occupation. I was greatly interested also in the record of those who have already gone forth from the school to take up land of their own, to hear how successful they have been in this new enterprise. The enterprise is at present small in extent, but surely it has great promise in it, and if only it could be extended to other districts throughout the whole of India a great deal might be done to relieve some of the present problems. It can be largely extended'.

Sir John Anderson, the then Governor of Bengal, inspected the working of the scheme on 24 July, 1933 and observed thus: 'It was to me a most interesting experience. During my visit the various processes of the farm—ploughing, transplanting, mixing manures, were being carried on by young *bhadralog* youths under training. This is a most interesting feature of the work at this farm. An attempt is being made to tackle the problem of *bhadralog* unemployment by training young men of middle-class families in agriculture and then settling them on the land as *khasmahal* tenants. The young men are given a year's training on the farm during which period they are required to work as common labourers at a daily wage and to share quarters on the farm. I saw their quarters during my visit and found them simple but healthy and neatly kept. They do everything for themselves there. It is early yet to say how far this most interesting experiment has succeeded and I understand that some at least of the young men trained on the farm are having a struggle to pay their way. This is, however, partly due to the flooding of the *char* lands on which they have been settled. I shall watch with interest the progress of the experiment'.

Changes in the laws relating to land are likely to be made soon but a scheme based on the lines mentioned above with necessary modifications may be prepared to suit the conditions of middle-class young men. It will mean no harm; on the contrary it will be good for the country to disseminate as much information as possible on the improved methods of agriculture and allied subjects. And it is high time to do it.

INTERNATIONAL CONVENTION ON PLANT PEST CONTROL SINGAPORE CONFERENCE

A CONVENTION detailing the measures to be adopted with a view to prevent the introduction of foreign plant pests and diseases in South East Asian countries was adopted at the Phyto-Sanitary Conference, which met at Singapore and was attended by representatives of 16 countries including India. The Conference was convened by the Commissioner- General for South East Asia of the Government of the U.K. with the cooperation of the F.A.O. of the United Nations. Dr H. S. Pruthi, Plant Protection Adviser of the Central Ministry of Agriculture, represented India at the Conference.

The main terms of the Convention which has been circulated to participating Governments include (a) legislation on plant protection in member countries; (b) measures for preventing the introduction of foreign pests and (c) to exercise such minimum control on specified plant imports as may be deemed necessary by the majority of the signatories. It was recommended that the area covered by the Convention should be: Brunei, Burma, Ceylon, China, Fiji, Hong Kong, India, Indo-China, Indonesia, Federation of Malaya, New Caledonia, New Guinea, North Borneo, Pakistan, Papus, Philippines, Portuguese Timor, Sarawak, Siam, Singapore and those islands in the Pacific Ocean bounded by Lat. 30°N. and 30°S. and Longt. 140°E. to 150°W.

Although organized plant protection work was started in India only three years back, legislation on plant protection and quarantine measures was passed as early as 1914. The Conference was greatly impressed by the Indian legislation and recommended it to member countries for consideration while adopting similar measures in their areas. India's plant protection work was considered to be run on sound lines and the Conference recommended many of the measures already existing in India for adoption by other countries in this respect.

What the Scientists are doing

RESEARCH ON PRAWNS

THE prawns are of considerable economic importance bacause of the protein food they provide. There is considerable demand for internal consumption as well as for export. The Indian Council of Agricultural Research has been sponsoring a scheme at the Madras University for the study of the biology of the marine prawns of commercial importance of the Madras Coast, with special reference to *Peneus indicus*, *Peneus carinatus*, and *Metapeneus monoceros*. This scheme has been recently completed.

It has been observed that the most common species among the marine prawns of commercial importance of Madras coast is *Peneus indicus*, the next in abundance is *Metapeneus monoceros*. The ratio of the occurrence of the three species in an average catch came to 15 : 1 : 2. All the species mentioned above were more plentiful in the brackish area of Cooum and Adyar. Of the total number of mature prawns collected from all the areas surveyed, the number of males was 1,386 and females 4,533. It is thus evident that the females are in excess of the males.

The gut contents of these penaeid prawns were composed of small fragments of different algae, a few protozooa and lower crustacea. It seems these prawns feed upon both vegetable and animal matter. No distinction in food materials either of the prawns collected from the sea coast or the backwaters and between the different age groups was noticed.

Full grown forms of these three species of penaeids occur in all the areas surveyed throughout the year. The immature forms were, however, found in large numbers in backwaters during the monsoon period, when there is free flow of water between backwaters and the sea. A slow gradation of growth can be seen from November onwards after the young stages have entered the backwaters, when the flow of water between the backwaters and the sea almost ceases. The rate of growth appears to diminish as the prawns grow older.

These prawns in their post-larval phases, about 10 to 25 mm. in size, enter the backwaters during the period of monsoon when the bar is open. This can be recorded as the time for inward migration of these penaeids from the sea into backwaters. The brackish water environments appear suitable for the quick growth of these young prawns. The grown-up prawns of the previous season present in the backwaters migrate into the sea for fuller growth and breeding. The larval forms of these penaeid prawns are recorded in the marine plankton only but not in the backwaters showing thereby that the breeding takes place in the sea. The cold monsoon period between October and February appears to be the favourable breeding season of these penaeids as the protozooa larvae of these crustaceans are observed in examinations of the marine plankton during this period, which can, therefore, be taken as the intensive breeding season of these prawns. (I.C.A.R.).

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. In parts of the United Provinces people store wheat straw in towers, the walls of which are made of *arhar* straws. The towers are thatched up at the top. The capacity of each tower is from 20 to 30 maunds, there being different sizes according to the quantity of chaff to be stored.

Such towers are called *burjis*. Can it be possible to fill such towers with green fodder for silage ? Ventilation can be effected through spaces between the stalks; but if air is not required the walls can be mud-plastered making the towers comparatively air-tight.

A. Throughout the civilized countries, where silage is made, the receptable for ensiling is constructed from various materials. Broadly speaking we have the pit silos and the tower silos. The materials used in the construction of these are: Concrete, masonry, concrete and masonry combined, stone and wood. Besides these, *katcha* silo-pits can also be used.

Whatever may be the material used in the construction of either a silo-pit or a silo-tower, the following points seem to be of paramount importance in the art of ensiling:

(i) The tower or the pit should be water and air-tight.

(ii) The walls or sides should be sufficiently thick in order to prevent the drying action of the sun.

(iii) When a considerable quantity of green fodder is packed into a tower, specially when the material ferments, there is considerable amount of pressure exerted by the material on the sides.

Burjis cannot answer the requirements mentioned above and, therefore, these towers cannot be used for preserving silage. (Y. C. G.)

MADRAS

T. S. FRANCIS

IN order to prevent the heavy toll of crops taken by pests and diseases year after year, the Madras Government have taken up measures to intensify plant protection work in the province. Four Plant Protection Officers (one Mycologist and one Entomologist at each of the two divisions of the province) and 52 assistants (two for each district) specially trained in modern methods of plant protection work and equipped with the most effective chemicals and machinery for pest and disease control have been appointed from January 1949. The Plant Protection Staff works in close collaboration with the Agricultural extension staff and attends to all calls for aid in controlling incidences of pests and diseases in the districts. The following is an outstanding instance of pest control work carried out in the province during the past few months.

The grasshopper (**Hieroglyphus banian** *F.*) *pest on paddy : Kistna District.*

During September, 1948 the grasshopper pest of paddy (*Hieroglyphus banian* F.) appeared in a severe form over 2,000 acres of the fertile paddy lands of Gannavaram and Gudivada *taluks* in Kistna district, and in a minor form over larger areas. As the pest was at the adult stage, the approved methods of controlling it at its egg stage were of no use and Gammexane D.025 (5 per cent benzene hexachloride) was dusted over small areas as an experimental measure. The results were startling. A very big death-rate of hoppers (both nymphs and adults) was noted in three to four hours after dusting and nearly 100 per cent mortality was recorded 24 hours after dusting. Encouraged by these results, larger demonstrations were carried out on the fields of cultivators in the worst infested villages. The cultivators were fully convinced of the efficacy of this treatment and came forward in large numbers for supply of the chemical and dusting appliances. To cope with this sudden demand, all the firms in Madras were immediately contacted and their stocks of dusters and Gammexane D.025 requisitioned and the campaign against the grasshopper was launched on a large scale. The campaign was pushed through with vigour using eight crank dusters each of which covered two to three acres per day and a power duster which covered 20 acres a day. Ryots were so enthusiastic about this treatment that they started dusting the affected fields with their hands and even this method proved effective.

A total quantity of 110 cwt. of Gammexane was used over about 800 acres. The cost of 20 lb. of Gammexane required per acre works out to Rs. 10-8 including the cost of labour required for dusting. The quantity of grain saved was on an average five bags, i.e. about 600 lb. per acre. The value of this produce works out roughly to Rs. 60 per acre. Deducting the cost of the treatment, the cultivator gained Rs. 50 per acre and the total benefit to the ryots of this area worked out at Rs. 40,000. Apart from this financial aspect, the fact that there was a saving of a total quantity of 4,000 bags of paddy at this time of general food shortage in the province is of great significance. Further, the marked success obtained with this insecticide against a common pest opens up great possibilities for wider application of this effective method of control.

The coconut nursery scheme

With a view to meeting the growing demand for quality seednuts of coconuts in Madras Province, the Government of Madras sanctioned

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in October, 1948 a comprehensive scheme for the establishment of coconut nurseries in the important coconut regions. The nurseries are located at the following centres: Samalkot (E. Godavari district), Pattukottai (Tanjore district), Pattambi (Malabar district), Nileshwar (S. Kanara), Palur (S. Arcot), Central Farm (Coimbatore), Marateru (W. Godavari) and Anakapalle in (S. Vizag district).

It is proposed to supply 1,60,000 seedlings from selected nuts every year from these nurseries. The Indian Central Coconut Committee has approved of this scheme and agreed to bear half of the total expenditure of Rs. 7,25,062 on the scheme spread over a period of five years.

The Government are contemplating the establishment of a coconut nursery in Tiruchirapalli district also under this scheme and proposals are under consideration.

Horticultural courses for fruit development in Madras

The Province of Madras abounds in resources for the development of fruit-growing and contains a very wide variety of fruits. In fact, Madras monopolizes the growing of some of the rarer types of hill-fruits and spice-producing trees in India. With a view to developing these great resources and make fruit-growing a paying industry the Government of Madras sanctioned in August, 1947, the proposal of the Director of Agriculture to start horticultural courses.

The Hon'ble the Premier of Madras inaugurated the first diploma course in Horticulture for 20 graduates and a certificate course for 25 fieldmen in August, 1948. The diploma course is for one year, the first nine months of which will be devoted for the actual training at the Horticultural Gardens, Teynampet, Madras (kindly placed at the disposal of the Director of Agriculture; Madras) and three months for tours to places of horticultural interest in South India for studying orchard practices of the various fruits under different climatic conditions. The majority of the students for the diploma course and all of the students for the certificate course are drawn from the personnel of the Madras Agricultural Department. There is provision in this scheme for training students from other provinces who may be deputed by their Governments. The scheme has been sanctioned for two years from the date of commencement in the first instance.

WEST BENGAL

P. S. MAZUMDAR

IN the context of food deficiency in Indian Union and the gloomy international food position, West Bengal, like every other province, is now strenuously endeavouring to speed up her agricultural development. She is now confronted with problems of enormous magnitude in that she has to produce enough food for her growing population ; in addition she has to rehabilitate East Bengal refugees and she has to produce sufficient raw materials required by her industries. A resumé of some of the more important recent developments in these fields in this province is given in this article.

Provincial Board of Agriculture, Animal Husbandry and Veterinary Aid

In the undivided Bengal, a Provincial Board of Agriculture, Animal Husbandry and Veterinary Aid was formed with a view to advise Government on all matters relating to the advancement of agriculture including animal husbandry and veterinary matters and fisheries. After partition of the province, this Board has been reconstituted. Since its inception, the Board has met twice, once in June and again in November, 1948, when it reviewed the various activities of the Directorate of Agriculture.

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Utilization of waste lands

A scheme to reclaim culturable waste lands by mechanical means has been taken up with the tractors at present available. Naturally, because of the small number of tractors available for this work, the progress is slow at present; but with the availability of more tractors, the pace of this work will be accelerated. At present work is in progress in Jalpaiguri district, where a block of 1,400 acres is being reclaimed. After reclamation the land will be settled with East Bengal evacuees.

To utilize railway surplus lands, 2,070 acres of such lands were leased to bona fide cultivators during 1947-48.

With a view to maximize the production of jute, the Jute Regulation Act, in force in this province, was amended to permit the cultivation of jute on waste lands. As a result, 66,420 acres of such lands went under jute, giving an additional production of 187,425 bales.

Irrigation

To extend the irrigated area, the following irrigation schemes have been taken up for implementation this year:

(i) Seven pumping plants, each of a capacity to command an area of 100 acres, have been hired out as a demonstration-cum-food production scheme to popularize pump irrigation in the province. A rent of Rs. 1,400 per set per year is charged from the user. This allows a subsidy of 50 per cent on the working cost.

(ii) Twenty minor irrigation and drainage schemes for excavating silted channels have been selected for implementation. Already two of them have been executed in the district of Burdwan, whereby 2,500 acres of land have been brought under paddy.

(iii) Preliminaries are being worked out of a pilot scheme to sink 40 tube-wells within an area of 6,000 acres.

(iv) One hundred and seventy-five Persian wheels, 20 Egyptian screws and 1,000 Dones are being manufactured for distribution among cultivators.

Plant protection

Potato, a very important cash crop of the province, badly suffers almost every year due to the attack of blight diseases. To fight these diseases, arrangement has been made to spray 7,000 acres in two important potato-growing areas in the plains this year. The work is in progress.

Work has also been taken up to treat paddy seed with Agrosan GN with a view to control seed-borne infection of Helminthosporium.

Jute seed multiplication

As a sequel to partition of the province, its jute industry has been very seriously affected due to her dependence for raw materials upon East Bengal. In order to increase jute production through use of improved seeds, a 300-acre jute seed multiplication farm is being established at Raigunj in the district of West Dinajpur where conditions suitable for raising jute seeds are prevalent. However, pending the establishment of the farm, improved jute seed has, this year, been multiplied in forest areas of Jalpaiguri and Midnapore districts as well as at some of our existing farms.

MAKING RICE MORE NUTRITIOUS

By PAUL WEST

MORE than 50 per cent of the world's population live on rice, the staple diet of many Asian countries. Rice has a lower nutritional value than grain, but it contains starch, minerals and most important of all—vitamin B, which years of research have proved to be indispensable in the prevention of the paralytic disease known as beri-beri, so widespread in Eastern countries. It is, therefore, essential that the valuable substances should be retained as far as possible during the milling of the rice grain for human consumption.

Rice-milling consists mainly of the hulling and whitening processes, the latter being known in some countries as pearling, polishing or scouring. Hulling removes the coarse, inedible husks which have no nutritional value and which if fed to cattle, can cause physical injury. After hulling, the rice is whitened, a process which imparts the brilliant pearliness to the rice grains.

The conventional mechanical methods of hulling and whitening, however, have the disadvantage that they tend to rob the rice of some of its mineral and vitamin B content. These valuable constituents are contained in the germ and in a thin aleurone layer of the bran. Hulling normally causes the germ to break. Tests have shown that about 95 per cent of the germ is lost in this way. In the subsequent whitening process, a large proportion of the aleurone layer is removed, so that the finished, highly-polished rice hardly contains any minerals or vitamin B. What remains is only a starch product.

Main principle

It is obvious, therefore, that the invention of improved methods of hulling and whitening augurs well in the interests of the rice-eating peoples of the world. A British firm has succeeded in constructing milling machines which do not harm the mineral and vitamin B content of the rice. One of these machines is the Wemanco Ideal Huller in which only a very small percentage of the germ breaks. This is due to the fact that the machine does not depend upon the use of milling stones or abrasives, but uses a combination of rubber and metal. Moreover, the husk is removed in a single operation.

The remaining treatment of the rice grain is replaced by gentler methods. The main principle involved is that the rice grain is transported to the shelling point on a continuous rubber band. The underside of the grain is embedded firmly into the rubber band so that it cannot slip about. On reaching the hulling point, the berries, containing the valuable constituents, are ejected from the husks. In this way, every ripe grain, irrespective of size or shape, may be hulled. The delicate tips of the grain do not get chipped; none of the nutritional endosperm is lost and even protruding germs remain intact. The machine is capable of hulling one ton of rice an hour.

Polishing process

The second machine is the Wemanco Ideal Whitener, a polishing machine operating on an entirely new, scientific principle. The whitening is carried out by means of a specially grooved rotor, the movement of which causes the meal to be peeled off the rice grain. At the same time, the mass of rice is subjected to a friction-process by a rapid pulsating movement. Throughout the entire treatment the rice is safeguarded from any undue pressure, so that the percentage of breakage is very low.

The finished rice leaves the machine with an attractive white pearliness. By means of a special regulating device, the degree of polish may be varied according to requirements. Should a few rice grains remain unpeeled in the machine, the husk residue may be disposed of by the action of the rotor. The machine which has a very low current consumption, is enclosed in a dust-proof metal casing and it is capable of dealing with 1,000 to 1,500 lb. of rice an hour.

These British-made Wemanco machines are the result of 50 years' research in the field of mechanical rice milling. Many rice-consuming countries have shown a lively interest in these new developments because they realize the importance of such inventions in raising the standard of diet and health among the rice-eating peoples of the world. (B.I.S.)

RESEARCH ON EGGS AT IZATNAGAR INSTITUTE

RESEARCH carried out on the production of eggs by Indian birds at the Indian Veterinary Research Institute, Izatnagar, show that under controlled conditions considerable improvement can be effected both in the quality and quantity of eggs produced. A pen of indigenous fowls was raised in 1939 from the ordinary bazar eggs at the Izatnagar farm. By pedigree breeding over a period of nine years, controlled system of feeding, housing and management the Institute has been able to produce 150 eggs per bird against an average production of a little over 100 in a year. Individual birds have laid well over 200 eggs each weighing near about 2 oz. Furthermore, these birds have stood well the adverse climatic conditions prevailing in the country. They eat relatively less, at the same time laying as many eggs as pure-bred fowls in this country.

Controlled breeding has also provided for increased rate of growth, early maturity, a definite and progressive increase in the weight of eggs as well as the average egg production of the hens. The improved village fowls of Izatnagar have won challenge cups and first prizes consecutively for two years at the All-India Poultry Shows held in New Delhi.—*Food Bulletin*, April 4, 1949.

Home Gleanings

NATURE CONSERVATION, NATIONAL PARKS AND BIO-AESTHETIC PLANNING IN INDIA*

By M. S. RANDHAWA

WE are indebted to Professer Lancelot Hogben for the term 'bio-aesthetic planning' which may be defined as conscious planning of the flora and fauna with the object of beautifying the country. Bio-aesthetic planning embraces both the animal and plant sciences, botany and zoology, and may be further defined as planned ecology of living beings from the artistic and aesthetic point of view. It includes the aesthetic planting of ornamental flowering trees along city roads, in parks, public places and compounds of houses both in towns and villages, planting of trees of economic values which yield timber, fuel and fruit along roadside and our national and provincial highways and district and canal roads, and on waste land in villages and development of national parks for the preservation of useful and harmless birds and animals, and creation of bird sanctuaries. The object of our bio-aesthetic plan for India is the encouragement of planting of selected ornamental flowering trees in our towns and villages, protection of beautiful harmless birds like wild ducks, egrets, geese and sarus cranes, by legal declaration of some of our big *jheels* (lakes) as bird sanctuaries, and preservation of graceful animals, which are being ruthlessly exterminated, such as black-buck, blue bulls, *sambhars* and spotted deer in national parks and zoological gardens in the vicinity of our big towns.

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A tree plantation plan

Just as we are planning the development of industrial and agricultural resources of our country, we should also have a national plan for encouraging the growth of fruit, timber and ornamental trees. In drawing the plan we have to consider the choice of trees for each climatic zone of the country and also take into view the soil and water supply. We have also to clarify our ideas regarding the choice of trees for various purposes, e.g. planting roadside avenues, city roads, canal banks, public parks, platforms in railway stations and compounds of private houses. We have to assign ornamental flowering trees, shade trees, timber trees and fruit trees to places where they can best fulfil their function. At present we see the irritating spectacle of fruit trees being grown indiscriminately in the compounds of houses, and timber trees in public parks and city roads.

The plan

In brief we may sum up our tree plantation plan for India as follows:

1. Bio-aesthetic planting for compounds of private houses, dak bungalows, banks, hotels, universities, colleges, schools, public offices, town roads, public parks and platforms of railway stations. For these places we should select trees with beautiful flowers and foliage to beautify them and to give pleasure to the people. *Kachnar*, pink cassia, erythrina, milletia, *amaltas* and *gul mohur* come under this category.

2. Roadside avenues of our national, provincial and district highways. The sole criteria for selection should be shade plus economic utility. For this purpose, trees which yield timber or fruit and are also shady should be

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* This is the concluding portion of the article; the earlier part has appeared in *Indian Farming*, June, 1949.

selected such as *mahua*, mango, tamarind, *neem* and *sheesham*.

3. Canal roads. We should plan all canal roads with fruit trees like mango, *jaman*, *kathal*, etc. The stones of varieties like *langra*, *dussehri*, *sufeda* and *fajri*, yield excellent fruit trees which are better than the *desi* mango. There are thousands of miles of canal roads which can be planted with fruit trees thus adding a valuable source of vitamins to the deficient dietary of our people.

4. Village plantations. Fruit, timber and fuel are the main requirements of villages. Fruit trees like mangoes, lemons, papaya, *kathal* and sweet limes are recommended for planting in the compounds of village houses, *phulwaris*, and along the bullock runs of wells fitted with Persian wheels. The plantation of *bakain* and mulberry trees in the compounds of cattle sheds should be encouraged.

Bio-aesthetic planting

Public places which belong to the community as a whole rather than individuals should claim preference in bio-aesthetic planting. A larger number of persons, especially those who are unable to afford private gardens of their own, will thus be able to enjoy the sight of beautiful flowers. Public parks and squares, public roads, platforms of railway stations, compounds of hospitals, universities, colleges and schools, ancient historical buildings under the supervision of the Archaeological Department, compounds of courts, office buildings of municipalities and district boards, and dak bungalows of the Public Works Department, Canal Department and District Boards are places in towns which are susceptible of bio-aesthetic planning and should claim preference in our programme for the beautifying of our towns and cities. Proprietors of hotels and banks, and owners of new bungalows should also be encouraged and given all assistance in the planting of ornamental trees.

Town planning and bio-aesthetic planting

Town planning and bio-aesthetic planting go hand in hand. Orderly and planned planting of ornamental trees can be seen to its best effect in new towns with wide roads flanked by shady footpaths, well-laid-out public parks and squares, rather than in congested old towns with narrow crooked streets. Our old towns offer little scope for bio-aesthetic planting. Firstly they contain no open places suitable for planting and secondly their streets and roads are too narrow.

Our old towns

Town planning is a precondition of bio-aesthetic planting. We have allowed our towns to develop without any plan or order. In our country *laisser-faire* has really gone amuck and the results have been most unfortunate. Ugly ill-ventilated houses joined together in monstrous piles along narrow, crooked lanes that is how our ancient towns like Old Delhi, Lucknow and Banares appear to an outsider whose eyes are accustomed to western orderliness. And not a patch of green in these prison-like piles of masonry. These houses may have been suitable in medieval, insecure times when security was the guiding principle in our domestic architecture rather than ventilation, but at present they appear anachronisms and fossils of a social and economic order which disappeared long ago. In these old towns, and their bazaars we see a reflection of our disorderly and undisciplined social and economic life. They may appear romantic to foreigners who come to our country in search of oriental mysticism and magic, but are certainly not fit for the growth of a healthy nation. It is time that we realize that we had enough of these smelly streets. The younger generation must be educated in a new mode of living. We must improve the environment which surrounds the individual in our towns.

Improving old towns

A very pertinent question arises about the fate of these old towns. What should be done with these ancient insanitary slums? These old towns are in need of drastic surgery. We must decongest these old residential areas by compulsorily acquiring suitable central housing areas, and after demolishing the ugly houses thus acquired, we should develop parks and open places in the sites thus acquired. Improvement Trusts have done useful work at Kanpur, Lucknow and Allahabad, but the rate of progress is snail-like and painfully slow considering the tempo of modern life and our requirements. In the parks thus made, bathing tanks should be constructed for the enjoyment of citizens in hot weather and incidentally for irrigating the trees and lawns.

The garden suburb should be our ideal in this hot country for vertical development is unsuitable considering the summer heat and flats are positively uncomfortable in hot months. Moreover, the development of motor transport has greatly facilitated horizontal and peripheral development of towns. So far as possible the growth of these garden suburbs should be planned in a concentric manner to economize fuel for motor vehicles.

New towns

With the influx of refugee population from Western Pakistan into India, the problem of raising new townships in the vicinity of old towns has assumed great importance as well as urgency. The surplus refugee population is mainly urban and must be absorbed in the urban economy of India. Besides there is also a proposal to build a new capital for the East Punjab. So the problem arises, what should be our ideal in this new town development? The garden city should be our ideal and the Welwyn Garden City in England, and the Model Town of Lahore provide an example which may be profitably followed in the development of new population centres. For our city of the future, *Le Corbusier* model with many-storeyed offices and factories linked with the garden suburbs by means of bio-aesthetically planted roads, will be very suitable. People will work in the production hub of the city during daytime and will scatter again in the garden suburbs in the evening enjoying their life in healthy, quiet, noise-and-dust-and-smoke-free surroundings.

Bathing tanks

Public bathing tanks should form an essential feature of these new towns. People can enjoy themselves in these tanks during summer and their waste water can be used for irrigating the public parks and gardens, which should be planted with ornamental flowering trees. Canals where available can also serve a useful purpose and also provide excellent opportunities for scenic planting and beautifying the towns.

Road plan and tree plantation plan

For our towns we are not only in need of 'road plan' for traffic but also 'tree plantation plans'. For every town of importance a 'tree plantation plan' should be drawn and rigidly adhered to. For new roads it is comparatively easy to plan plantations of unfamiliar flowering tree, and it is the old roads which present a problem.

The only practical solution is replacement of dead, decaying and old trees according to a plan. Once a plan is made, it should be rigidly followed not only in new plantations but also in replacements.

Choice of trees

While shade and economic utility should be the criteria for selecting trees for national, provincial and district roads passing through the countryside, different types of trees are required for town roads. For roadside avenues in towns and cities, shade and beauty are the sole criteria which we should consider while selecting trees. Unfortunately there are very few trees which combine shade with beauty of flowers, for the large majority of our flowering trees are deciduous. Where space available is so limited that only one row of trees can be grown on each side of the road, flowering trees like *gul mohur*, *amaltas*, *Jacaranda*, *Erythrina* and *Spathodea* may be grown alternating with shade trees like *Eugenia operculata*. Choice should be restricted to one species only for each street. Very tall trees like *Eucalyptus* and *Millingtonia*, and trees with spreading crowns like banyan, are unsuitable for town roads, for they interfere with electric wires. Medium-sized trees like *Eugenia operculata* and *pakur* (*Ficus infectoria*) which are extensively grown in New Delhi, are ideal for shade while for beauty we have a large number of trees to choose from.

Double avenues for cities

Double avenues of trees are a necessity in big cities, where wide roads are available.

The outer row should be of shade trees like *Tamarindus indica*, the inner of ornamental flowering trees. The outer row should be composed of evergreen shade trees with dense foliage, such as *Tamarindus indica*, *Polyalthia longifolia*, *Eugenia operculata*, *Purtanjiva Roxburghii*, *Mimusops elengi*, *Ficus retusa*, *Azadirachta indica and Ficus infectoria*. The function of the outer row is to provide only shade. These trees should be planted in pure avenues. The inner rows should be planted with ornamental flowering trees only. The outer rows of shade trees will provide shade for pedestrians on the footpaths and at the same time will furnish a green background for the pink, red, crimson and yellow flowers of the flowering trees.

Some colour schemes

While most of the flowering trees look beautiful when planted in pure avenues, there are some species which flower at the same time and the colour of their flowers also harmonizes and hence they appear more effective when planted together. Some of the flowering trees which flower in the same season are grouped below in schemes with due regard to colour harmony and are recommended for planting along our town roads.

Yellow flowered *Cassia fistula* grown alternating with *Poinciana regia* provides a very striking colour scheme, the rich yellow colour of *amaltas* flowers contrasting with the scarlet orange colour of *gul mohur* blooms in the month of May when both the trees are flowering.

The three varieties of *Bauhinia variegata*, pink, white and purple-mauve, and light magenta (*B. Krugi*) grown alternating with each other is suitable for dust-free roads of residential areas. All these Bauhinias blossom in a leafless condition from the middle of February to the middle of March when they look like huge bouquets of pink, white, purple and light magenta flowers.

Tree planting plan for New Delhi

The tree plantation plan of the modern city of New Delhi can serve as a model for many of our towns. When Sir Edwin Lutyens came to New Delhi, he asked for a list of trees which could grow here. Griessen of the Horticultural Department prepared a list of trees and tree-like shrubs that might be made use of in the planting of the New Capital at Delhi. Griessen planted the first laid-out roads, but on account of unsatisfactory water supply most of the roads had to be replanted several times. Griessen retired in 1920 and was followed by Mustow who established the nursery at Jor Bagh opposite the Safdar Jung Tomb. Henceforward all tree-planting in New Delhi owed its existence to Mustow. He afforested the ridge. He introduced the *Prosopis juliflora* from Mexico, and thus gave India a hardy tree which may even help to make Rajputana green. Generally roadside avenues were inter-planted; quick growers between the permanent and slow growers. Most of that inter-planting has been cut out. Extensive use has been made of many of our flowering trees for brightening up the housing areas, squares and circuses. For roadside avenues *Eugenia operculata* with its light green leaves has been found to be the most suitable. It sheds its leaves in late February, and renews them in early March, after remaining leafless for only a few days. It has a compact semi-globose crown and its light green leaves appear very soothing to the eyes. Avenues of these beautiful evergreen trees adorn the parks on both sides of the Kingsway and are also planted on many roads. Other successful roadside trees are *Kigelia pinnata*, *Pongamia glabra*, *Ficus retusa*, *Ficus infectoria*, *Celtis australis*, *Sterculia alata*, *Cassia fistula*, *Anthocephalus indicus*, *Piptadenia oudhensia*, and *Melia azadirachta*.

The Secretariat and the Viceregal buildings are the nucleus of the lay-out of New Delhi and a number of roads radiate out from them. The clipped bushes of *Diospyros cordifolia* in the lawns in front of the Government of India buildings look very attractive. The trees annually receive a light pruning treatment, the branches being cut at a certain distance above the ground. This leaves space for pedestrians to wander below, and the Pathan-type of hair-cut, which the trees receive, gives them a trim and smart appearance. The clumps of Jacarandas at the corners of the two Secretariat buildings are a sight in the month of April.

Most of the circuses in the centre of road junctions are enlivened with clumps of flowering trees like Jacarandas, *amaltas*, *gul mohurs* and *kachnar*. Where space available is narrow, use has been made of shrubby climbers like the various species of *Bougainvillaea* and *Petraea volubilis*.

The squares in housing areas have been planted with all types of flowering trees. The *semals* in Hastings Square with their flaming red flowers are a sight in the months of March and April. Purple and mauve *kachnars* lend their grace to many squares, though they have a rough time at the hands of inhabitants who pillage their buds ruthlessly for preparing curry.

Flowering trees have also been planted at the edges in the compounds of bungalows which are maintained under the supervision of the Public Works Department. At the gateways bottlebrush trees with pendulous branches are commonly grown. We also find trees of *Jacaranda mimosaefolia*, *Bauhinia variegata*, *B. purpurea*, *Etryhrina indica*, *Grevillea robusta* and *Ochna squarrosa*. In the foreground extensive use has been made of ornamental shrubs and pink oleanders lend their gay note to many bungalows of the Capital. Scented shrubs like *Murraya exotica* and *Cestrum nocturnum* exhale their perfume in many bungalows. No attempt has, however, been made to vary the planting scheme, and as a result all the bungalows look alike. By adopting different combinations of trees and by planting some of the flowering trees in pure avenues, New Delhi could have been made more colourful. Another defect from which the plantation scheme for compounds of New Delhi bungalows suffers is that fruit trees have been totally ignored, and too much emphasis has been laid on mere ornamentals. Plantation scheme of New Delhi can be very much improved, if fruit trees like grafted mangoes, citrus plants, figs, and papayas compromise between beauty and utility.

Plantation plan for our highways

A plantation plan for our National, Provincial and District Board highways is urgently wanted. In drawing such a plan, climate of a place, its temperature, rainfall, soil and water-level should be carefully considered and suitable species selected.

Avoid mixtures. On account of indiscriminate planting and thoughtless replacements our roadside avenues have become very much mixed. It is very essential that mixtures of different species be avoided and we should have pure avenues of a single species for long stretches. This will not only improve their appearance but also render their management more economic, re-plantation easier and will rationalize their exploitation for commercial purposes. If *mahuas* and *neems* are grown in pure avenues for miles, oil-crushing industry can be easily started in such districts. Due to growth in compact areas there will be saving in transport charges. Similarly furniture-making industry can be encouraged in sub-Himalayan districts which specialize in *sheesham*, *sal* and teak. Tamarind fruit which now only serves as a staple diet of monkeys, can be profitably exported to Western Pakistan. *Mahua* can be used for the manufacture of power alcohol.

Shade. The main function of a roadside avenue is shade. Hence those trees which are quick-growing and provide dense shade should be selected. The trees selected should provide shade not only at sides, but also in the centre of the road. From this point of view trees with an umbrella or sub-umbrella crown like *neem*, *mahua*, *imli* and *am*, are more suitable than trees with a linear, elongated crown like teak, *Eucalyptus* and *Millingtonia*. If these trees provide shade, and also yield valuable timber or fruit, they are still more desirable. The trees should be planted 40 ft. apart so that their crowns may develop freely. Where the road is more than 100 ft. wide a double avenue of trees, with the outer avenue near the boundary line, should be grown. A section of Lucknow-Rae Bareli road has such a double avenue and the road is very shady and cool.

Selection of trees. Trees for various roads should be selected with due regard to rainfall, soil, temperature and water-level. Only those trees should be grown along roadsides which provide thick shade and are also valuable from the economic point of view. The following trees which are shady and also yield products of economic value, are recommended :

Neem (*Azadirachta indica*)
Mahua (*Bassia latifolia*)
Imli (*Tamarindus indica*)
Sheesham (*Dalbergia sissoo*)
Mango (*Mangifera indica*)
Sufed siris (*Albizzia procera*)
Pitheclobium saman (Rain Tree)

Trees unsuitable for roadside avenues. The following trees should on no account be planted along the roadside :

Eucalyptus (all species)
Millingtonia hortensis (*neem chambeli*)
Eugenia jambolana (*jaman*)
Albizzia lebbek (*kala siris*)
Cassia siamea
Ficus glomerata (*gular*)

All these trees are fragile with very weak wood and consequently break easily in a wind-storm. The result is that after a heavy storm roads become blocked and traffic is stopped for a considerable length of time, and during a storm these trees are a positive menace to the lives of unfortunate travellers who happen to be on the road. Besides *Eucalyptus* and *neem chambeli* have linear, elongated crowns which provide poor shade.

Thorny trees. The following trees are thorny and their thorns are a nuisance to pneumatic tyres of small cars, cycles and motor-cycles.

Acacia arabica (*babul*)
Acacia modesta (*phulahi*)
Zizyphus jujuba (*ber*)

Ideal village plantation

Village *shamilat*, the common land which is used for pasturing cattle, is ideal for village plantations. Old fallow land which has been out of cultivation for a long time can also be taken up for plantation purposes. The question is whether these plantations should be raised and managed by individual farmers or by the village *panchayat*. Plantation under the supervision of the *panchayat* and common ownership of the trees is an ideal solution, but the difficulty lies in the lack of corporate sense in many villages. Usually we find that everyone's responsibility is no one's responsibility, and trees planted with great effort are grazed by cattle. So we have to adopt both the remedies. In a village where a *panchayat* is functioning successfully the plantation should be raised by the *panchayat* which can also appoint village young men as guards for protecting the trees for the first two years.

In some villages it would be more feasible to partition the village waste-land into units, one to five acres in area. These plots should be enclosed by *kutcha* walls to give protection to young trees. Where water table is fairly high, a *kutcha* well may also be dug in the plot. Near the boundary wall thorny fuel trees like *babul* or mesquite (*Prosopis juliflora*) may be planted. In the middle area fruit trees like *desi* mango and *kathal* may be planted. The fruit trees may occupy 25 per cent of the area and the remaining should be covered by fuel and timber trees.

Celebrating tree-planting weeks

A 'Land and Development Act' has been passed recently by the Central Legislature for the centrally administered areas of Delhi Province and Ajmer Merwara. Under this Act a Development Commissioner will be appointed who, assisted by a Board, will prepare schemes on many such matters as the preservation and improvement of soil, prevention of soil erosion, development of horticulture and planting of forest trees, control and maintenance of tree growth, and planting or sowing of trees, shrubs and grasses for the purpose of afforesting uncultivable land, etc. If practicable schemes are prepared and implemented with vigour, this piece of legislation will be of great use.

A country, however, cannot be legislated into progress, and the mere passing of an Act does not provide a remedy for a vast problem. The ambitious tree-planting scheme we have outlined requires a nation-wide effort for its implementation. The importance of tree-planting must be brought home to all our countrymen, and by organizing tree-planting drives and weeks the entire nation must be enthused. With this object in view a Tree Planting Week was celebrated in Delhi Province in July, 1947 which was inaugurated by Pandit Jawaharlal Nehru, Sardar Patel and Shri Rajagopalachari. The Week was a great success and all the parks and public gardens of Delhi were planted with beautiful flowering trees whose flowers will lend their grace and beauty to our Capital six years hence. Our main object in celebrating this week to was focus the attention of our people to the natural importance of tree planting. As Mahatma Gandhi commented in one of his evening post-prayer speeches: "The official who originated the idea of tree planting did not do it for fancy, nor was it meant for monied men. It began with them so that others would copy them and thus add to the wealth and rainfall of India". The idea of celebrating Tree Planting Weeks has caught the imagination of the people, and since last year such weeks were celebrated in many provinces. Planting of trees is regarded as an act of virtue in India, and as the trees we have planted grow up, they will remind our younger generation of the message of a nineteenth century poet:

He that planteth a tree is the servant of God,
He provideth a kindness for many generations,
And faces that he hath not seen shall bless him.

Book Reviews

POTATO

By W. G. Barton. (Published by Messrs. Chapman & Hall, London, pp. 319, 25s.)

THE potato now occupies a prominent place in the world food economy; its total world production exceeds that of wheat and rice. The position, second only to cereals, which the potato has won for itself, is ascribed to several different causes, not the least important of which is its intrinsic merits as food. Besides being mainly a starchy food—a crop of potatoes yields about twice the quantity of starchy food as wheat or rice from the same plot of ground; potato contains considerable amounts of protein, minerals and vitamins B and C. It has, however, certain disadvantages. It is not an ideal food to transport; it is readily bruised and in consequence suffers considerable loss during transport and storage. It is subject to several diseases, particularly the virus diseases, which take a heavy toll of the yield. A great deal of research work has been done on this crop, since its first introduction into Europe from South America in the sixteenth century, and there is a considerable volume of literature dealing with the various aspects of its production and utilization. W. G. Barton, in this book, has summarized the available information dealing particularly with 'the yield of the crop as influenced by various factors such as the climate, soil, manuring and varieties'. He has also discussed at length 'what proportion of this yield consists of potentially nutritive matter, and what factors influence this proportion, its composition, its loss during cooking and the quality of the cooked tubers'. The question of storage of potatoes from the point of view of eliminating losses and retaining the nutritive value of the tubers, has also received his attention. This book is a valuable addition to our knowledge of the potato as a source of food and should serve as a guide to all those interested in furthering its use as such.

The book is divided into ten chapters. The first chapter deals with the introduction of the potato from its original home into the European countries, the history of its development in British Isles, its annual production and consumption. Chapter two briefly outlines the origin of the varieties, the bases of their classification and the characteristics of a few important varieties. The succeeding four chapters, which form an important section of the book, discuss the question of yield and dry matter content of the potato as influenced by seaon, soil, cultural and manurial practices, variety and disease. Throughout emphasis is laid on the complex interaction of these factors in influencing the yield. In chapter seven, the analysis of the tuber is discussed with reference to its structure, composition and proportion of its constituents. Chapters eight and nine deal with the nutritive value of the tuber as judged by the extent to which the various constituents are digestible and the proportion lost during the process of preparation and cooking. The criteria of quality of the various forms of cooked potato are also given. The methods of storage are discussed in detail in the last chapter in relation to its effects upon nutritive value and culinary quality. Reference is also made to the uses of potato other than for human consumption in an appendix.

The book consists of 270 pages of easy reading matter with a number of useful tables, diagrams and a few plates. There are also three appendices and an author index, an index of potato varieties and a subject index at the end of the book. Relevant references to literature are given at the end of each chapter. (S. R.)

CENTRAL ARECANUT COMMITTEE CONSTITUTED

THE Government of India have decided to set up a Central Arecanut Committee for the improvement and development of the production and marketing of arecanut and its products. The Committee will consist of the Minister for Agriculture, Government of India, as President and the following members: The Agriculture Commissioner and the Marketing Adviser, Government of India; a representative each of the Ministeries of Finance and Commerce to be nominated by the Central Government; four members of the Dominion Parliament who are neither growers of nor traders in arecanut who will be nominated to represent consumers; eight members representing arecanut growers of whom four shall be nominated by the Government of Madras, one by the Governments of Travancore and Cochin and one each by the Governments of Bombay, Assam and Mysore; seven persons representing the Departments of Agriculture of Assam, Bombay, Coorg, Madras, Mysore, Travancore, Cochin and West Bengal to be appointed in each case by the Government concerned, and six persons representing the trade in arecanut, one each being nominated by the Government of Madras, Mysore, Travancore and Cochin, the All-India Supari Federation, the Federation of Indian Chambers of Commerce and Industry and the Palghat Chambers of Commerce.

Inter alia the Committee will assist and encourage agricultural, industrial, technological and economic research in arecanuts; produce, test and distribute improved varieties of seed; encourage the adoption of improved methods of cultivation; assist in the control of parasites and diseases which affect arecanut; encourage the adoption of improved measures for arecanut marketing; give financial and technical assistance to organizations engaged in growing, processing, grading and marketing arecanut, establish a market intelligence service and recommend maximum and minimum prices to be fixed for arecanut and the controlled purchase and distribution of arecanut imports.

The Government of India will give an annual grant to the Committee not exceeding Rs. 5 lakhs and will appoint a Secretary and Cooperative Arecanut Marketing Officer to assist the Committee.

The establishment of the Central Arecanut Committee follows the recommendations made by an *ad hoc* committee set up by the Indian Council of Agricultural Research in 1946, which considered the preliminary measures necessary for affecting improvements in the arecanut industry. The Central Government had been receiving numerous representations from individual producers and arecanut associations in South India on the difficulties facing the industry. These were: Lack of scientific research to improve the cultivation and production of arecanut, the ravages of diseases and the ill-developed marketing methods in existence. The possibilities of cheap and heavy imports of arecanut from the Strait Settlements, Ceylon and other areas in South-East Asia, and their depressing effect on the prices of the indigenous variety were also stressed, and it was suggested that there should be some control to regulate the marketing of the Indian and the imported varieties.

Madras is the largest grower of arecanuts in India with 107,000 acres under this commodity and Coorg the smallest with 800 acres only.

The Hon'ble Shri Jairamdas Daulatram, India's Agriculture and Food Minister, who is the President of the newly constituted Arecanut Committee, has appointed Mr. K. Madhava Menon, Minister of Agriculture, Government of Madras, to be its first Vice-President.

PLATE 38

The new plough evolved by the Indian Agricultural Research Institute.

I.C.A.R. ENQUIRY ON MEDICINAL PLANTS AND FOOD POISONS

A SCIENTIFIC enquiry, extending over a period of 12 years, on Indian medicinal plants and food poisons which was launched under the auspices of the Indian Council of Agricultural Research in 1935 has now been completed and Col. R. N. Chopra, at present Director, Drugs Research Laboratory, Srinagar, who conducted the enquiry has submitted his final report to the Council.

Publication of a monograph on poisonous plants in India, establishment of a herbarium of medicinal and poisonous plants, preparation of an Indian Pharmacopœia and encouragement to the cultivation of medicinal plants in the country are some of the tangible achievements arising out of the scheme. Besides, the results of the enquiry have also been of considerable assistance to the establishment of the Central Drug Research Laboratory at Lucknow.

The Report says that the enquiry has definitely advanced the knowledge with regard to pharmacopœial and allied drugs in India. A number of firms manufacturing drugs from Indian medicinal plants have come into existence and, instead of depending on concentrated extracts from foreign countries, practically every kind of galenical powder extracts are now being manufactured in India from materials produced in the country.

India is the emporium of all kinds of medicinal herbs and drugs and, with suitable facilities, she can produce not only enough for her internal requirements but also considerable quantity for export. The enquiry has stimulated cultivation of medicinal plants. Among drugs which have been brought into extensive cultivation may be mentioned belladonna, digitalis, hyoscyamus, colchicum, gentian, ephedra, pyrethrum, etc.

Poisonous plants of which there are a large number in India and which are constant danger not only to animals but even to human beings have been studied and a much needed warning against their indiscriminate use by the unqualified practitioners of indigenous systems of medicine has been sounded. Some food poisons of this country such as *khesari dal* (*Lathyrus sativas*), Indian millet (*Sorghum vulgar*) and *sialkanta* seeds (*Argemone maxicena*) which have been responsible for producing serious outbreaks of food poisoning among men and animals have been studied. However, only fringes of this vast problem have so far been touched and much more work remains to be done.

A monograph on poisonous plants of India has been prepared in two volumes of which the first volume is expected to be published shortly.

A herbarium on medicinal and poisonous plants in India has been established. This contains about 1,730 species of medicinal plants out of about two thousand found in India. This herbarium is consulted by scientists, medical practitioners, pharmacy students and industrialists.

ERRATA

Indian Farming, Vol. X, No. 5, May 1949: Page 189, Col. 1 line 37, *for* 'Degree of Science' *read* 'Degree of Doctor of Science.'

Page 190, Col. 2 line 3, *for* 'persons of India' *read* 'persons in India': line 24, *for* 'His was the life' *read* 'His was a life.'

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PLATE 30

The Hon. Shri Jairamdas Daulatram addressing the Second Annual Convocation for the award of diplomas to the students of the Statistical Training Course of the Indian Council of Agricultural Research held at New Delhi on May, 1949.

Seated at left of the Hon. Minister are Mr. K. L. Punjabi, Secretary, Ministry of Agriculture and Shri S. M. Srivastava, Joint Vice-Chairman, I.C.A.R.

CHICAGO

INDIAN FARMING

AUGUST, 1949

Vol. X No. 8

THE TASK BEFORE STATISTICIANS*

WHEN I find in front of me such a large assembly of statisticians, I ask myself whether I am in any way qualified to address you. Probably the only reason why I am asked to address you is that I happen to be one of those who represent free India in the governmental sphere. Free India has had to deal with many tasks and free India will have many more equally big tasks to handle in the future. One of the big tasks which free India has to handle is to increase India's agricultural production to the maximum extent possible. When a country is inhabited by as many as 35 crores of men and when out of these 35 crores roughly 80 per cent live in the rural areas and most of this 80 per cent depend directly and indirectly on agriculture, the position which agricultural development has to occupy in such a country can only be of the topmost priority. For more reasons than one, India has to attend to its agricultural development. Let us take the important question of raising the standard of living of the people. We all know that our masses residing in the villages live on the land and all their prosperity or their poverty is linked up with what their land produces. If the masses have to increase and improve their standard of living, they can only do so if they have the purchasing power to do so. Therefore, the standard of living of our agricultural masses can improve only when our land produces much more than it does today. This increased production will place in the hands of the agricultural masses greater purchasing power with the aid of which they can raise the standard of living. So also linked up with agricultural development is our industrial development. India's industries, if they have to develop to the utmost, must find the purchasers of industrial products among the masses of India. From many points of view, apart from the point of view of the contentment of the agricultural masses, it is recognized that we should produce far more from the land than we do today. All this means very careful planning and speedy implementation of those plans. But planning is impossible unless we have facts before us. We cannot plan in a way which is out of touch with the realities of the situation. It is here that the science of statistics comes to our aid. It constitutes the light which enables us to see the path on which we are treading. Let us take a simple question; let us take the question which probably some of you have studied. One of the biggest crops in this country is wheat. To protect our wheat we are trying to evolve rust-resistant varieties. We can only do so by experiments in the field and it is for you to assess the results of those experiments. But without the statistician we are likely to go astray. It is the statistician who knows as to what exactly we have to do, which variety of wheat evolved in the laboratory sown under what conditions, in what quantity, in what texture of the soil, irrigated with how much water and subject to which other varying conditions is to give us the maximum yield. All these are matters which statisticians examine carefully and so plan correctly and estimate the results accurately. I do not want to go further into these technicalities but I wish to stress the point that a statistician can be very helpful in the proper planning and execution of agricultural programmes in this country.

You have been trained in an Institute which has not yet come to occupy the place which it merits. Hard work is being done in this

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*Address by the Hon'ble Shri Jairamdas Daulatram on the occasion of the I.C.A.R. Convocation, held on 4 May, 1949, for awarding diplomas to the statistical trainees.

Institute in a plain building in unostentatious surroundings under the direction of Dr Sukhatme, who occupies an important place in the international circle of statisticians. His unassuming appearance may not help you to realize how high is his reputation in the world of statisticians.

India is faced with many big tasks and it is the duty of everybody that free India should be able to fulfil each big task. One particular task which has relationship with our statisticians, one big venture, one big challenge which Government have set before themselves and before the whole country is that by 1951 we shall liberate India from the bondage of foreign food. And statisticians have quite a responsible and big part to play in the achievement of this task. The correct planning as to what should be done, the correct estimate of the results of what has been done, all this will be your task. I, therefore, appeal to all of you that apart from any personal considerations, let this national consideration inspire you to feel that among the thousands and lakhs of other workers who have to participate in this great task, you also will have an important part to play. You will help to determine our plans, you will help to implement those plans and you will help to estimate the results of those plans. I hope this spirit will continue to guide you not only during these two years but so long as you remain and function as statisticians.

Original Articles

ROMANCE OF THE REBORN SUGAR INDUSTRY IN INDIA*

By T. S. VENKATARAMAN

THOUGH it is widely known that the Benares Hindu University owes its origin to our revered leader, Pandit Madan Mohan Malvyaji, it is within the knowledge of only a few that the rebirth of the Indian sugar industry was also initiated by Panditji. It was he who drew the attention of the Government of India to the deteriorating position of the home industry caused by imports of cheap white sugar from Java. At the instance of the legislature, the Central Agricultural Board initiated work in two directions. One was on the manufacturing side and consisted of trying to evolve a unit in between the modern sugar factory and *gur* manufacturing methods. To the Station at Coimbatore was entrusted the task of producing improved sugarcanes for the country. This is because the canes in cultivation over the bulk of India were easily some of the poorest in the world.

New canes

In view of the fact that canes imported from other countries were mostly failures, the station at Coimbatore attempted to produce new canes within the country by suitable breeding. At that time the opinion was strongly held both in India and outside that sugarcanes did not produce fertile seeds under Indian conditions. The first sugarcane seedlings that germinated were too carefully grown and under such artificial conditions that most of them died out. An attempt was therefore made to germinate the seeds in the open and under natural conditions exposed to both the sun and rain of India. This resulted in quite a large number of germinations which gave the suspicion that they were all only grasses and not real sugarcane seedlings. The order was therefore given that they should be destroyed to prevent discredit to the attempt. Fortunately, however, a holiday intervened between the order and its execution. This enabled a reconsideration of the matter and it was decided to keep the seedlings for a couple of months but removed from public view. If ordinary grasses they would show themselves up by the time. The wells in Coimbatore are very deep and the seedlings found a lodging in the berm of these wells hidden from public view. These plants, which later proved to be genuine sugarcane seedlings, were thus born and grew under some form of imprisonment. This reminds one of the manner in which great men were ushered into this world. Lord Jesus was born in a manger and Lord Krishna in a prison.

When the Indian Sugar Committee of 1920 visited our chief source at that time of white sugar, namely Java, both information and plant material were freely given to India as it was thought at the time that India could never count in the white sugar world. It was then more than half a dozen years since the Coimbatore station was started on a temporary basis and its productions were beginning to show some promise in the experimental plots of certain provincial stations. Even so, the committee which contained men of knowledge and experience made bold to recommend the continuance of the Coimbatore attempt.

Productions from Coimbatore

The productions from Coimbatore had many vicissitudes during their infancy and childhood stages. Being on a temporary basis the retrenchment committee constituted at the time by Government to effect economies naturally paid its first attention to Coimbatore. Fortunately, however, the canes from Coimbatore, though yet grown only in small plots, had attracted the attention of a group of sugar factories in Northern India under European management. This was because of the enthusiasm of the Sugar Bureau under Mr. Wynne Sayer who was able to get grants from the factories for expanding this work. As hard headed businessmen had placed belief in the possibilities of the Coimbatore attempt, it was easy for the Government of India to continue the station though for short periods and on temporary basis.

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* Summary of a popular lecture delivered by Dr T. S. Venkataraman at Walchandnagar, on 10 February, 1949 on the occasion of the Eleventh Meeting of the Indian Central Sugarcane Committee.

At that time certain of the scientists at Pusa had developed a hostile attitude to the Coimbatore productions. The now famous Sir Albert Howard opined that the flowering of the Coimbatore canes showed weakness. He also mentioned that the higher yields would quickly impoverish our soils. Mr. G. Clarke who was in-charge of the most important sugarcane station in the U.P. pinned his faith in the Java canes which he had imported and which he was pushing into the cane belt. He felt that Coimbatore could not come up to the level of the Java canes and therefore practically banned the cultivation of Coimbatore cane near his station. Perhaps, the first favourable report of Coimbatore work came from distant Cuba where Co. 281 was found to be a useful cane. The factory at Nellikuppam in South India came to know of this and obtained planting material of this cane from Coimbatore.

Apart from the above there existed a popular prejudice against these productions because they were new. Some North Indian cultivators thought that because of their flowering the Coimbatore canes would ultimately develop weakness. It was even believed at the time that *gur* from Coimbatore canes would cause impotency.

Amidst these gloomy environments credit is due to the first Tariff Board which definitely realized that there was some possibility in India to develop a strong home industry. It has to be remembered that at the time the Coimbatore productions were practically confined to experimental plots in Government farms. The Coimbatore canes soon spread into cultivation and easily established their superiority in the grower's fields. Planting material of certain of these canes were even stolen from experimental stations and one such cane, rejected by the Experiment Station at the time, served the industry in a remarkable way for some time. This shows that when an improvement is real it does not take much labour to put it across to the Indian cultivator.

The Coimbatore productions soon came to be known in the other sugarcane stations of the world and indents began to pour in from other sugar stations on the basis of exchange of material. Today, the Coimbatore productions have shown their use in many parts of the world from Cuba and Peru in the West to Australia in the East. In fact, the Coimbatore work came to be known in the other parts of the world earlier than most other achievements of the Agricultural Departments in the country.

Basic factors

If one were to examine the basic factors on which the Coimbatore work was built up these may be summarized in three words: sincerity, boldness and high endeavour. From the very commencement the persons in charge of Coimbatore work concentrated their sole attention on only one object namely, the production of improved canes for India. Secondary issues of however great scientific interests were religiously eschewed to conserve the energies of the station for the main work set before it. This aspect, research with a definite aim, is very important for real scientific advance. Unfortunately, this is not always realized in the country. Again, the Coimbatore scientists pursued in their endeavour new and bold lines in their scheme of hybridization. The programmes followed were frowned upon by orthodox text-book scientists. Today the Coimbatore sugarcane station has got a range of parent material comparable and, in some cases, superior to the other sugarcane stations of the world. For success in the future the station needs a personnel with high enthusiasm and boldness to follow up the new and novel lines of hybridization laid down during the past three decades of its existence, and freedom to carry on its work unhampered by official red tape and all that it connotes.

MANUFACTURE OF PALM CANDY

By S. C. ROY and B. C. JOSHI

WITH the introduction of prohibition in certain palm-growing provinces of the country, attention of the Central Government as well as the public is being diverted to the development of the age-old cottage industries of palm *gur* and palm candy manufacture in India. So far, a large quantity of palm juice was being used for alcoholic fermentation and the fermented product had become a regular commodity in trade. This juice has now to be converted into crystallized sugar using improved processes and equipment. A separate department devoted solely to the development of the indigenous industries of palm jaggery and candy manufacture has been started under the Palm *Gur* Adviser to the Government of India. This department has started many research centres all over India and the development work is in full swing.

India is the largest palm sugar producing country in the world. The average annual production being about 174 tons[1]. Palm sugar or candy making industries are mostly located along the coast line of the country where palms thrive best. There are many varieties of palms growing in India, but only a few varieties yielding higher percentage of sugar are used for the manufacture of palm jaggery. A good bit of this jaggery undergoes a refining process and turned into palm candy.

In view of the importance of the subject, a study of the indigenous processes of palm candy manufacture, as practised in certain parts of West Bengal, was taken up and experiments were undertaken to effect improvement in the plant and process of manufacture of palm candy from palm jaggery.

Indigenous method of palm candy manufacture

The process was studied at the spot during a visit to a palm candy manufacturing concern at Calcutta. A sample of the jaggery was brought from Calcutta and analysed. It had the following composition :

Brix.	Pol.	Py.	*p*H.	Red sugar	Ash
89·01	71·20	79·99	6·1	5·078	3·00

Ordinarily the jaggery is poured into gunny bags which are hung by hooks to drain off the liquid substance from it. Later these bags are pressed to drain out adhering molasses. The sugar so obtained is somewhat lighter in colour. This is dried and stored.

This sugar from palmyra palm jaggery is melted in an iron pan over an open-fired furnace. Clarification is effected by adding diluted milk and skimming off the scum. At this stage, some Hydros is also added to it to improve colour. Strike temperature is judged by means of the ‘ thumb method. ’ The concentrated liquor is transferred to *tals* and kept for crystallization for about a week. These *tals* are similar to those used in sugar candy manufacture. After the crystallization is over, the *tals* are punctured and the mother-liquor is drained out. Draining goes on for two or three days. During this time the candy is also dried. It is taken out from the *tals* and cut into small pieces, packed in bags or tins and sold. The total yield of candy is only about 20 per cent on the weight of jaggery.

The drained mother-liquor is further concentrated and kept into drums for crystallization. After three or four days the crystallization is complete, and small dark crystals are formed inside the mass. These crystals are separated from the mother-liquor by straining through gunny bags. The crystals so separated are mixed with the original palm sugar and boiled off for another crop of candy.

The mother-liquor drained is unfit for any further candy crop. A sample of this mother-liquor was brought from Calcutta and analysed. It was found to have the following composition:

S. C. ROY is Director of Indian Institute of Sugar Technology in India and B. C. JOSHI is Chemist, Sugar Candy Research Scheme of the Institute.

---

[1] *Report on the Marketing of Sugar in India and Burma*, **1943.** Marketing series No. **39.**

Brix.	Pol.	Py.	pH.	Red sugar	Ash
76·45	56·80	74·29	6·0	10·58	3·80

This is either sold away to tobacco manufacturers for blending it with tobacco or used along with coal-tar for painting roads, etc. Some licentiate distillers use this mother-liquor for the manufacture of alcohol as well.

Improving the quality of palm sugar from palm jaggery

With a view to introducing improved methods for the manufacture of palm candy, it was proposed to conduct a few experiments on the manufacture of a better quality of palm sugar than that usually taken out from palm jaggery.

Palmyra jaggery was obtained from the Agricultural Officer, Ellore. The jaggery was almost solid and had a very dark appearance. It had the following composition:

Pol.	...	82·40	per cent
Sucrose	...	78·43	,, ,,
Glucose	...	3·02	,, ,,
Moisture	...	5·66	,, ,,
Ash	...	1·97	,, ,,

The following experiments were conducted with the jaggery mentioned above:

Clarification: A melt of 70° Brix of the above jaggery was prepared and treated with different proportions of milk, carbon, phosphoric acid and alumina cream. The treated melt was boiled and filtered. The filtrates were analysed for colours. The results are tabulated in Table I.

TABLE I

Classification of palmyra palm jaggery melt. Brix.—70°. 100 c.c. melt was taken for treatment in each set.

Set No.	Treatment	Colours (reading taken in $\frac{1}{8}$ in. cell)				Observations
		Y.	R.	B.	*Total*	
1	Control	13·9	4·6	0·3	18·8	Very dark and turbid
2	Melt—1 c.c. milk	11·8	3·4	0·1	15·3	do.
3	Melt—5 c.c. milk	10·3	3·2	0·1	13·6	Dark and a bit turbid
4	Melt—1 gm. carbon—2 c.c. milk	10·0	3·0	–	13·0	do.
5	Melt—2 gm. carbon—2 c.c. milk	10·6	2·2	–	12·8	Lighter but a bit turbid
6	Melt—5 c.c. alumina cream—2 c.c. milk, 1 gm. carbon	9·8	1·7	–	11·5	Lighter but not very clear
7	Melt—100 c.c. alumina cream	8·2	3·8	–	13·0	do.
8	Melt—50 c.c. milk	6·6	1·6	–	8·2	Much lighter and clear
9	Melt—1 drop of H_3PO_4—1 gm. carbon	5·2	1·8	–	7·0	Clear and bright

As a matter of fact the melt was very dark. It was not advisable to dilute it further because of higher fuel consumption. The lightest filtrate was obtained with set No. 9 when one drop of phosphoric acid and 1 gm. of carbon were added to 100 c.c. of melt. It will be seen from the results that better clarification of the sample of jaggery was difficult.

Crystallization of sugar from palmyra jaggery: Palmyra jaggery was melted over steam in the melting pan. Clarification of the melt was effected by using 4 per cent carbon, 2 per cent milk and a little superphosphate solution. Analysis of the melt was as below:

Brix.	Pol.	Py.	pH.
76·70	68·35	89·11	6·6

One per cent Hyflo was used as filter aid and the melt filtered through a filter press. The filtered liquor was concentrated over steam to a concentration of 83·70° Brix. The concentrated mass was transferred to a Magma-mixer where it was cooled and stirred.

After about two hours' stirring, the mass was purged in a centrifugal and the crystallized sugar was separated. The molasses which separated out had the following composition :

Brix.	Pol.	Py.
66·45	54·75	82·39

The sugar so obtained was of a light brownish colour. It was of the following composition :

Pol.	...	96·2	per cent
Moisture	...	0·943	,, ,,
Invert sugar	...	1·730	,, ,,

	Y.	R.	B.	*Total*	
Colours	28·4	6·0	0·4	34·8	(½ in. cell)

The sugar so made was used for the manufacture of palm candy as described below.

Manufacture of palm candy

The sugar was melted in a melting pan and the melt clarified using 1 per cent carbon and 2 per cent milk. The treated melt was filtered through a filter press. The filtrate was analysed and found to have the following composition :

Brix.	Pol.	Py.	*p*H.
71·40	67·58	94·66	6·8

The filtrate was concentrated over steam to different concentrations and transferred to *tals* for crystallization. After a duration of eight days the *tals* were drained and the candy examined. Results have been tabulated in Table II.

TABLE II

Crystallization of palm candy

Maximum temp. °F.	Minimum temp. °F.	Humidity
84·2	55·7	64·00

Set No.	Strike temperature °C.	Analysis of concentrated syrup			Yield of candy	
		Brix.	Pol.	Py.	Percentage of yield	Quality
1	108	80·00	74·97	93·72	26·3	Too poor, very small crystals, colour dark
2	109	81·44	76·75	94·24	30·4	Poor crystals, a bit bigger, of darkish colour
3	110	82·50	77·68	94·16	35·0	Medium sized crystals, darker
4	111	83·72	78·59	93·88	38·4	A few well formed bigger crystals, good top layer
5	112	85·00	80·11	94·25	37·8	Good general crop, closely compacted

It will be seen from Table II that candy in all cases was rather dark. This was chiefly due to the bad quality of the jaggery. Lower concentrations did not give good yield of candy. Maximum yield was obtained from a strike temperature of 111°C. Compared to the strike temperature in case of sugar solutions, this temperature was 1·5°C. higher. This higher temperature might be due to the non-sugar content of the jaggery itself.

The candy obtained was dried and cut to pieces. The average analysis of the candy obtained is given below :

Pol.	...	97·50	per cent
Glucose	...	0·266	,, ,,
Moisture	...	0·619	,, ,,
Ash	...	0·188	,, ,,

Flow diagram for palm candy manufacture

On the basis of the above experiments a flow diagram as shown in Fig. 1 is given. The process consists of :

(a) Melting the jaggery in a melting tank of suitable capacity. Brix. of the melt to be adjusted to 70°C.

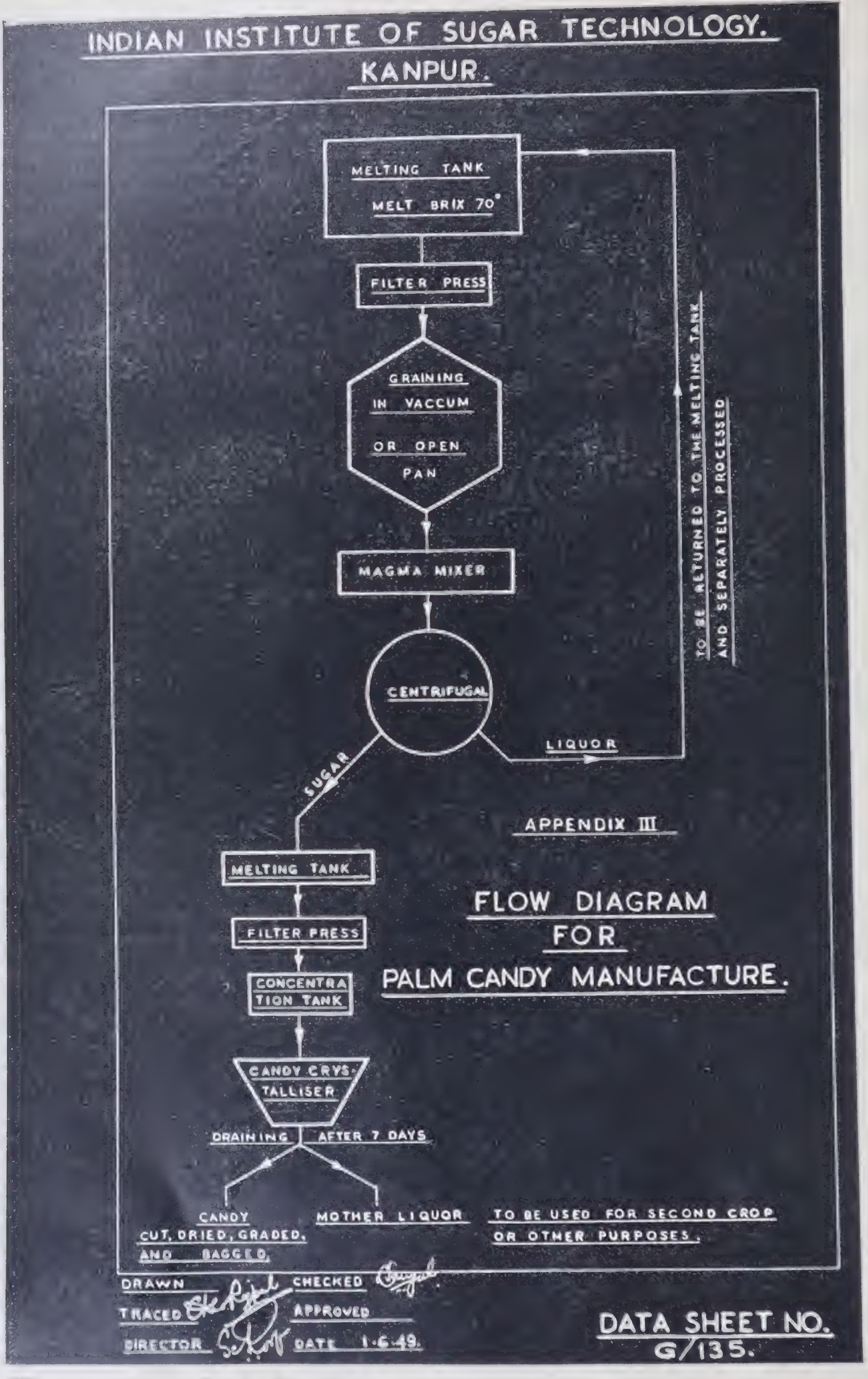
INDIAN INSTITUTE OF SUGAR TECHNOLOGY.
KANPUR.
MELTING TANK
MELT BRIX 70°
FILTER PRESS
GRAINING IN VACCUM OR OPEN PAN
MAGMA MIXER
CENTRIFUGAL
SUGAR
LIQUOR
TO BE RETURNED TO THE MELTING TANK AND SEPARATELY PROCESSED
APPENDIX III
FLOW DIAGRAM FOR PALM CANDY MANUFACTURE.
MELTING TANK
FILTER PRESS
CONCENTRATION TANK
CANDY CRYSTALLISER
DRAINING AFTER 7 DAYS
CANDY CUT, DRIED, GRADED, AND BAGGED.
MOTHER LIQUOR
TO BE USED FOR SECOND CROP OR OTHER PURPOSES.
DRAWN
TRACED
DIRECTOR
CHECKED
APPROVED
DATE 1.6.49.
DATA SHEET NO. G/135.

FIG. 1. Flow diagram for palm candy manufacture.

(b) Clarification of the melt using adequate quantities of activated carbon and milk. The quantities will depend on the quality of the jaggery. Hyflo to be used as filter aid.

(c) Filtration of the melt through a plate and frame type of filter press.

(d) Concentration of the clarified liquor over steam preferably under vacuum to a concentration of 80° to 82° Brix. (If vacuum pan is used the liquor is to be grained to a massecuite).

(e) In the absence of a vacuum pan the concentrated liquor to be grained in a water jacketed Magma-mixer.

(f) The massecuite so formed to be centrifuged in a centrifugal and the sugar washed.

(g) The sugar to be melted in the melting tank, clarified and filtered.

(h) The filtered liquor to be concentrated over steam to a concentration of 82° to 84° Brix.

(i) The concentrated liquor to be transferred to crystallizers.

(j) Crystallizers to be drained after seven days and candy separated, dried and bagged.

(k) A second crop of candy if desired to be taken from the mother-liquor after due clarification, etc.

Utilization of the palm candy mother-liquor

Manufacturers using the indigenous system of palm candy manufacture usually sell the mother-liquor to tobacco manufacturers for blending with tobacco. Some use it for the manufacture of certain varieties of sweets.

Experiments were conducted at the Ravalgaon Centre to device ways and means for a better disposal of the mother-liquor. As a result of a series of experiments it has been found possible to convert the liquor into a type of syrup which very closely resembles honey. In countries like Brazil where palm candy is manufactured on a large scale, the whole of the mother-liquor is usually converted into what they call 'palm honey'.

WASTE PRODUCTS OF COFFEE

IT was known for a long time that the pulpy residue from the coffee bean was a good feed for cattle. It remained a waste product for the simple reason that cattle did not like the taste of it and therefore would not eat it. At a cooperative experiment station in El Salvador, American and Salvadorean researchers, by experimenting with additional ingredients, evolved a formula that made the material palatable to milk cows. The waste material can now be used as a substitute for corn. If all the coffee pulp in Latin America were converted to cattle feed, a not impossible task, it would provide the equivalent of about 34 million bushels of corn a year. Such an achievement would be significant for both the health and the economies of the Latin American countries, which are now producing only a small percentage of the milk their peoples need. *Technical and Scientific Co-operation Bulletin, Public Affairs Department of State, U.S.A.*, February 1949.

FRUIT FOR THE MILLIONS

By MURARI PROSAD GUHA

NATURE'S nursery is in the tropics, the region of colour, warmth and sunshine, and the best for vegetation. Some of the best fruits of the world are to be found here and banana is one of them. This cheapest and possibly the best fruit of India is being cultivated here from the dawn of civilization; the Ajanta frescoes (443 B.C.) depict the fruit in high state of cultivation.

Decandolle[1] records that banana is cultivated for more than 4,000 years in tropical Asia and its antiquity and wild character are indisputable facts, there being a good many sanskrit names. The botanical generic name *Musa* is derived from the Arabic *Mouz* or *Mouhoz* as sages ate its fruit and reposed beneath its shade.

Origin and geographical distribution

Although, as has already been said, the natural home of banana is in the tropics, wild and cultivated varieties have made themselves at home in sub-tropical regions, and even in cooler regions as in the Himalayas, where it is found in the wild state even at 4,000 ft. to 6,000 ft. and is cultivated at 7,000 ft. above sea-level. It has spread all over the tropical world probably from its original home in India or Malaya and today it is grown throughout the warm regions, except the desert areas which are too arid.

Banana found its new home in Africa probably earlier than it was carried to the land of Arabian nights. Probably it spread to the islands of the Pacific before any explorer visited them.

But the present mass production of banana in the West Indies and tropical America had its origin from Canary Islands, where the plant reached in 1516 A.D.

Important varieties

The two most important varieties, from point of view of utilization are *paka kala* (banana) and *kacha kala* (plantain), the former eaten raw and the latter eaten after being cooked. All our Indian varieties are confined to only one sub-species *sapientum* under the species *Musa paradisiace.* The dwarf form (*Musa Cavendishii*), known as *Singapuri kala*, is very popular throughout India, differing from the others in that it loves a cooler climate and the fruit when ripe remains the same pea-green in colour.

The most outstanding variety in the whole world is the Gros Michel, a tall tree with long, comparatively slender recurved yellow fruit with strong stem. This variety alone dominates the whole of the tropical American plantations as well as those of the Pacific Islands and bananas worth about $50,00,000 are shipped from these regions yearly.

The most important provincial varieties are: Sabri or Martaman and Champa in West Bengal; Poovan and Nendan in Madras; Basrai and Tambadi or Tambeli in Bombay; Champa in Assam; Anpan and Chinia or Chunia Kela in Bihar; Palanpodan and Yethen in Travancore; Rasabale and Salambale in Mysore.

The varieties Martaman and Lalchal in West Bengal and Bombay respectively as well as the hill bananas of Madras are rather costly and are generally preferred by the rich.

Why cultivated

It has been estimated[2] that the total area under banana and plantain is about 20 per cent of the total area of two million acres under all fruits in India and next to mango which has the highest acreage of all fruits. Of all the provinces Madras has the maximum acreage, next comes West Bengal, although due to partition the major area has gone over to Eastern Bengal. The present acreage in West Bengal might be more or less some 50,000 acres. As is revealed by available statistics banana gives the maximum yield per acre (being highest in West Bengal yielding 500 maunds per acre)[2] and as such can support a greater number of people, the units of

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[1] Decandolle, Alphonse (1884), *Origin of Cultivated Plants*, p. 304.

[2] *Report on the marketing of Bananas in India* (1945) Central Agricultural Marketing Department, India.

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calorie produced per acre being highest than a similar area of any other crop under the most favourable conditions. Moreover, this huge produce can be preserved indefinitely by preparing meal from the dried fruit without affecting the food value.

The available quantity for consumption *per capita* in India was 22·9 lb. (loc. cit. 2) annually (15·2 lb. in England—all imported), this being highest in Bengal (87·1 lb.) and lowest in U.P. (0·5 lb.). Unfortunately this fruit does not reach the millions in our country though in the last few years the production *per capita* has increased considerably.

The young innermost leaf of banana is used as a dressing for burns as well as for covering boils and blisters. From *Ayurvedic* point of view plantain curry is a recipe for bowel troubles and the roots and stems are tonic, antiscorbutic and useful in disorders of blood.

Description of the flower

The flower is trimerous and the inferior ovary carries on it the irregular perianth in two parts, one called the *perigonium* representing five perianth lobes, and the *scale*, representing the sixth. Besides the usual five stamens, the sixth rudimentary or fully developed one is also found sometimes. Of the gyneocium, the ovary is tricarpillary and syncarpous, one style and single stigma with undulating surface. In unusual cases, the number of styles is three. Transitional stages are also found.

Fruiting time

The average time taken to bear the first crop of fruit is 10 to 12 months after planting, though there is a great variation in fruiting time among the different varieties or even among individuals of the same variety, the minimum being six months and the maximum 14. At maturity the inflorescence emerges from the rhizome through the pseudo-stem and large number of flowers are closely crowded in the axils of the bright protecting bracts. The inflorescence bends over and when a sufficient bunch of fruit has set, the pendant extremity (*mocha*—used as vegetable) with the remaining unopened flowers and bright bracts, should be cut away to give better scope for the remaining fruits to develop, which in most cases are seedless. The *Singapuri* banana takes the maximum time for fruiting, viz. two to three years. Usually at intervals of five months or a little more the successive crops are secured.

After full growth and ripening the bunch of fruits is severed and hung up in a dark warm place for further ripening and the plant is cut and removed to give room for the development of the young suckers. The stalk of the inflorescence (*thor*), coming from the rhizome through pseudo-stem, is utilized as vegetable.

Number of fruits in a plant and yield per acre

The number of fruits varies among different varieties, though it much depends on soil condition and manuring, the minimum being 50 in a bunch and the maximum 200. Annually the average yield per acre in India is 155 maunds[2]. In Bengal the yield per acre is 500 maunds; Mysore gives the lowest yield being 35 maunds only. Other provinces give the following yields: Assam—200 maunds; Madras—160 maunds; Bombay—135 maunds; Bihar—90 maunds; and Travancore—49 maunds.

Food value of the flesh of the fruit

The value of the banana fruit has already been realized from the fact that it produces maximum calories per acre. Barnell[3] even goes so far as to say that 24 bananas (presumably large ones) with milk, would provide a balanced diet for an dult doing no manual labour. However, a comparative self-explanatory chart adapted from Datta[4], of the best two fruits of India is given below:

Protein	...	0·15	0·1
Fat	...	01·7	0·1
Starch	...	18·2	7·9
Vitamin A		**	*
Vitamin B		—	*
Vitamin C		****	*
Vitamin D		—	*
Vitamin E		—	**
Ca	...	—	*

[3] Barnell, H. R. (1940), The banana in relation to human nutrition. *Trop. Agric.* **17,** 148–146.

[4] Datta, S. *Science and Culture,* **XI,** (8), 394.

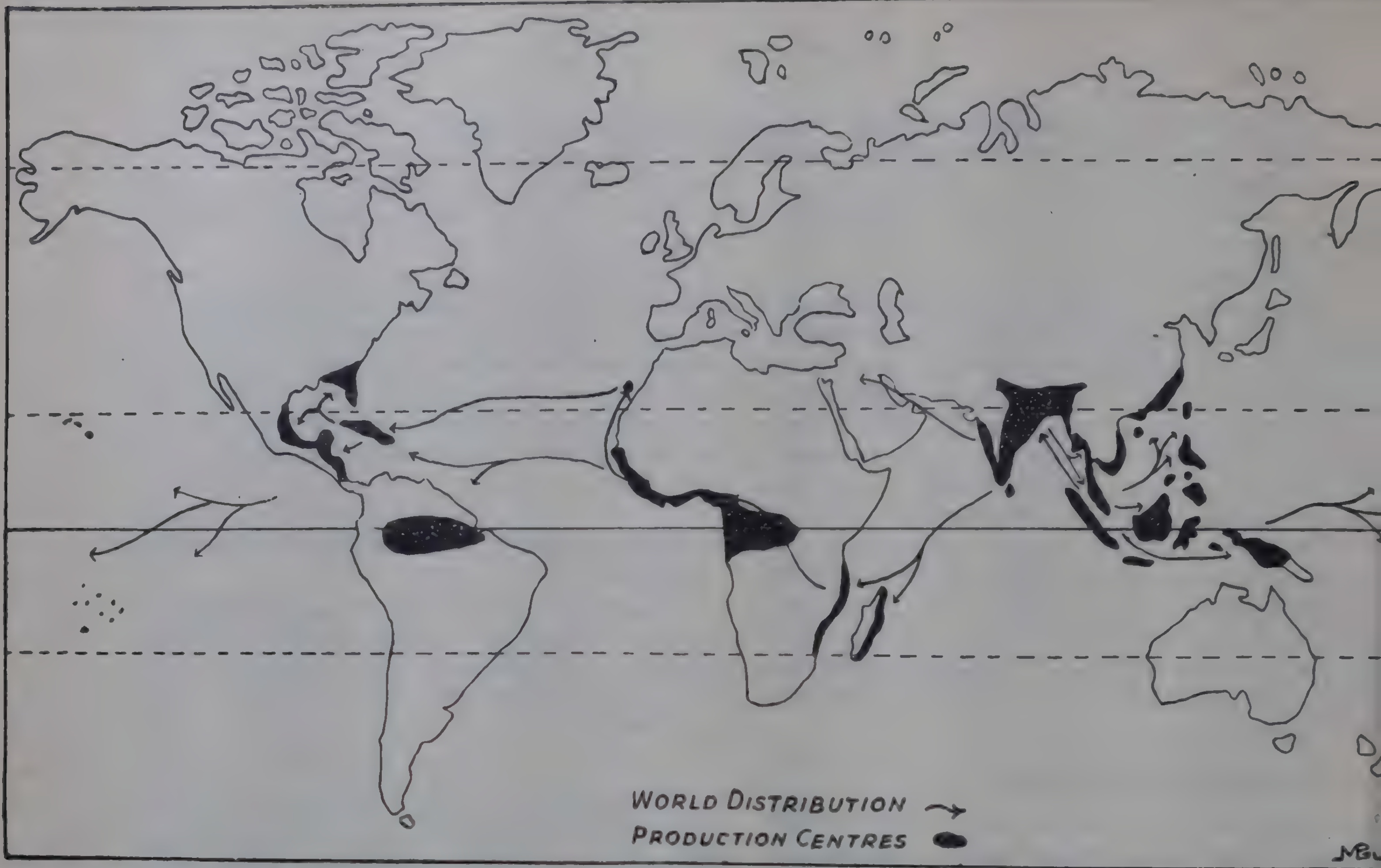

WORLD DISTRIBUTION →
PRODUCTION CENTRES ●
MBu

FIG. 1. Probable line of distribution of banana throughout the tropical world has been shown with arrows. The pres
production centres are shaded.

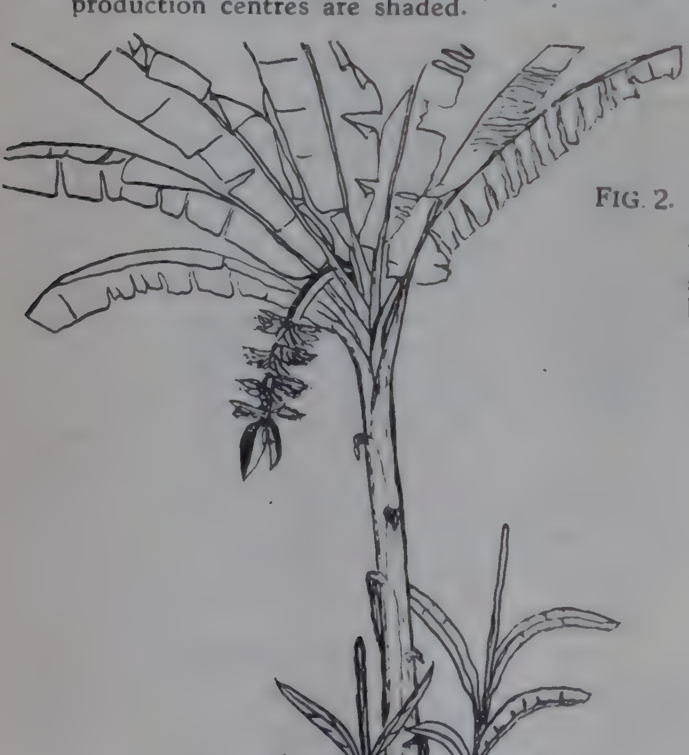
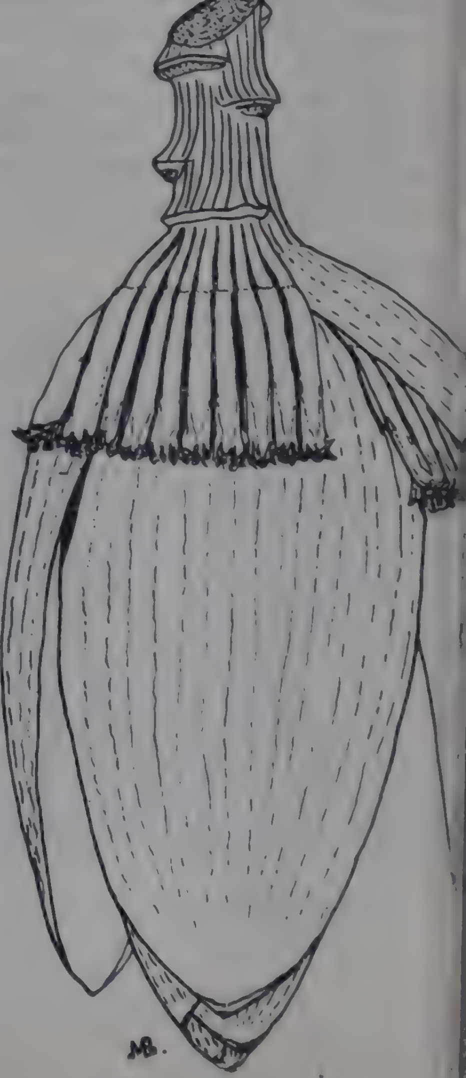


FIG. 2. A fruiting banana plant, with two baby suckers. The rhizome and the root system are also shown below ground level.

FIG. 3. An inflorescence with the bright bracts and cluster of flowers. The scars of fallen bracts as well as the flowers can also be seen.



Fe	...	*	*
Po_4	...	—	**

— Indicates either nil or not ascertained.
* Indicates the presence of a good quantity.
** Indicates the presence of very good quantity.
*** Indicates the presence of rich contents.

Acid content in banana is presumably negligible, both when green and ripe, as opposed to Mango.

Soil and climate

Subject to a liberal supply of water and sunshine, suitably close to a tank, ditch, *jhil*, canal or a river, banana can be grown in almost all soils, except where the soil is heavy and the sub-soil is hard rock or stiff clay. In one word the soil should be deep and well drained. Banana being a gross feeder, maintenance of soil fertility is of supreme importance. Where virgin soil is brought under plough the question of manuring does not crop up at once, but attention must be given to this question in the future. In poor soils the plantations should be removed every ten years and less exhaustive crops should be grown if the land is not left altogether fallow.

In India banana is cultivated from Cape Comorin to Himalayan heights and is thus subject to a wide range of climatic conditions. But it is a lover of warm, moist climate with a high degree of rainfall. This is why banana grows best in Bengal; next comes Madras and then Bombay. The extreme climates of Northern India hinders the extension of banana plantation there.

Propagation

After ripening of the bunch, the pseudostem bearing it is cut back close to the rhizome, and from here lateral off-shoots or suckers are developed and the growth is continued by them. Thus, the life of the individual plant is indefinite. The extra suckers (there should not be more than three at the base), are removed for establishing new plantations in June or July. Sometimes sections of rhizome with one or two buds are also used for propagation.

Preparation and planting

Where virgin soil is brought under plough, the question of preparation is not a problem but in case of cultivated lands, preliminaries for the preparation of soil is of supreme importance. Firminger's[5] method is recommended : Soil operation should be begun any time before rains, let us say in January. Soil is deeply ploughed and left to the action of the elements. Then just as the rains break, sunn hemp (*Crotalaria juncea*) at the rate of 40 lb. of seed per acre is sown. This will come up vigorously with the rains. After some weeks it is cut down and ploughed *in situ*; let it rot well to harrow again. At the end of the rains, pits, 12 ft. apart, are dug for the fruit trees and between them a crop of deep-rooted legume is given to break up the sub-soil,—a short season groundnut, such as small Japanese, is admirable. The nuts are harvested and the roots, stem, etc. are retained to the sub-soil.

One year after the start of soil operation suckers are planted in pits within fields of standing *aus* paddy, arum, brinjal, ginger, if not nuts already mentioned. The suckers should preferably be 'maiden' suckers, i.e. suckers about eight months old, with adult foliage as opposed to 'sword' suckers, which are younger with narrow leaves. As has already been said, suckers are usually planted in the rainy season. The pits should be about a cubit deep and should be manured. Sometimes dried banana leaves are burned and put into the pits to check termites; fresh cowdung is also added.

Maintenance of soil fertility

However rich the soil may be, the fertility level should always be maintained *at par* as banana is a gross feeder. Baillon[6] *et al* found that the banana plant absorbed from the soil a moderate amount of nitrogen, little phosphorus and a very large amount of potash, the latter accounting for 10 per cent of total potash lost from the soil. In India similar results were, however, obtained by Norris and Ayyar[7] as early as 1925. The scheme of manuring should be aimed at maintaining the equilibrium of the replenished earth. In India farmyard manure, oilcakes and bonemeal are used as well as wood ash and bonemeal, though the latter were not frequently used by the orthodox

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[5] Firminger, T.A.C. (1890). *A Manual for Gardening for Bengal and Upper India*, 175.

[6] Baillon, A. F., Holmes, E., and Lewis, A.H. (1933). Composition and nutrient uptake of the banana plant with special reference to Canaries. *Trop. Agric.* **10**, 139-44.

[7] Norris, R. V. and Ayyar, C. V. R. (1925). The Nitrogen and mineral requirement of the plantain. *Agric. J. India* **20**, 463-7.

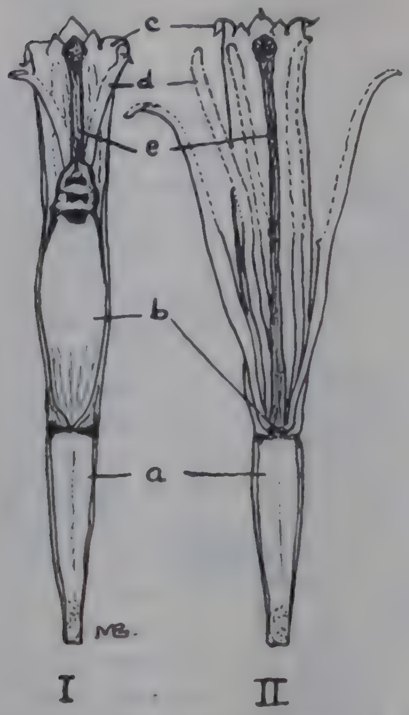
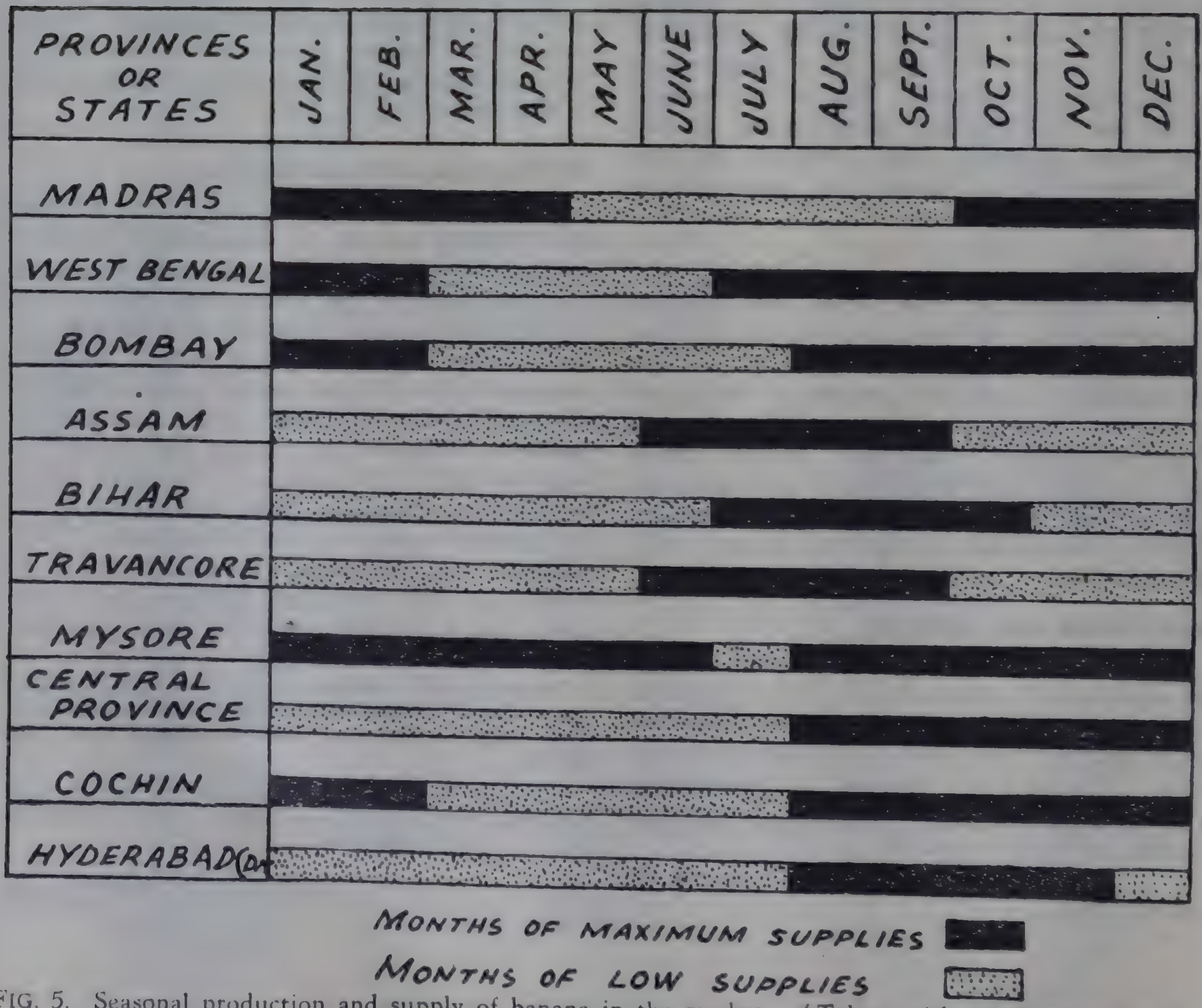


FIG. 4. Flowers of banana I & II. a, the inferior ovary; b, the *scale*; c, the perigonium; d, the stamens and e, the style with the stigma. In fig. II, the scale has been removed to show the position of the style and stamens.



PROVINCES OR STATES	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
MADRAS	■	■	■	■	▨	▨	▨	▨	▨	■	■	■
WEST BENGAL	■	■	▨	▨	▨	▨	■	■	■	■	■	■
BOMBAY	■	■	▨	▨	▨	▨	▨	■	■	■	■	■
ASSAM	▨	▨	▨	▨	▨	■	■	■	■	▨	▨	▨
BIHAR	▨	▨	▨	▨	▨	▨	■	■	■	■	▨	▨
TRAVANCORE	▨	▨	▨	▨	▨	■	■	■	■	▨	▨	▨
MYSORE	■	■	■	■	■	■	▨	■	■	■	■	■
CENTRAL PROVINCE	▨	▨	▨	▨	▨	▨	▨	■	■	■	■	■
COCHIN	■	■	▨	▨	▨	▨	▨	■	■	■	■	■
HYDERABAD(Dn	▨	▨	▨	▨	▨	▨	▨	■	■	■	■	▨

MONTHS OF MAXIMUM SUPPLIES ■

MONTHS OF LOW SUPPLIES ▨

FIG. 5. Seasonal production and supply of banana in the market. (Taken with modifications from *Marketing report of Banana in India*).

cultivators earlier. Compost is now a byword If, however, this excellent manure is not available, fresh nightsoil may be used. Firminger (loc. cit.) suggested 15 lb. of F.Y.M., 5 lb. of bonemeal and 7 lb. of wood ash per plant for the first year and 5 lb. F.Y.M., 5 oz. of bonemeal and 1 lb. of wood ash per plant for the second year. Green manuring is desirable once a year and the soil must be kept well hoed.

Control of diseases and pest

Panama disease (more popularly known as banana wilt caused by the fungus *Fusarium cubense*) first attracted attention in Panama and Costa Rica early in this century, and caused serious loss and abandoning of cultivation in large areas in the West. From the survey of the banana areas of tropical America and West Indies, it has been concluded that fundamentally the disease developed as the result of unfavourable soil conditions. Flood fallowing of areas affected by wilt has given effective results as has been definitely concluded by Wardlaw[8] from observations and experiments carried out in the West. This flood fallowing, however, may not be successful in the case of acid soils.

In the East, serious loss is caused by a disease, which passes under the name of 'bunchy top' and was originally supposed to be associated with the attacks of the nematode, *Heterodora radicicola*. This supposition has been reviewed by scientists who have indicated that the disease falls into the group of virus diseases not directly transmissible. In this case the agent of transmission is the aphid, *Pentalonia nigronervose*; Ocfemia and Cartimisan[9] definitely concluded that there was no association between the disease and the nematode. This trouble has been effectively controlled by the total destruction of the diseased plants.

The black rot disease, caused by the fungus *Gleosporium musarum*, is responsible for the loss of fruits on the plant as well as in the store. Spraying with ammoniacal copper carbonate prevents it from the malady. There is scope for raising improved varieties, especially disease resistant ones, through breeding.

The question of quarantine measures which of late has been in the limelight should be seriously considered. For example, banana wilt is a serious disease and occurs in Madras; therefore, suckers imported from the province must be certified free from wilt to check the spread to other provinces; the same method should be applicable to other diseases as well. It is a remarkable fact that banana has no serious insect pest in India which can justify control measures.

Earth worm (*Pheretima indica*) creates havoc sometimes, specially where rainfall is very high. It enters the pseudo-stem from the earth and even goes up to the young inflorescence and is responsible for the black scars on the fruit.

Planning a plantation

Cultivation of banana and plantain is based on two different considerations. One is for trade and the other for home consumption. For the former big commercial plantations are required and for the latter, a part of the kitchen garden.

The first consideration of planning a plantation is the selection of site. It should be as near a city and a railway station as possible, otherwise marketing will be greatly hampered for transport difficulties. The approximate cost of cultivating one acre has been estimated[10] at Rs. 225 as detailed below:

(1) Cost of 350 plants	...	Rs. 45
(2) Cost of planting in the pit	...	Rs. 35
(3) Cost of ploughing, etc.	...	Rs. 20
(4) Cost of manure, etc.	...	Rs. 125
Total	...	Rs. 225

Apart from the cost of cultivation, cost of maintenance, supervision and fencing has also to be incurred, which are not detailed, as also the profit which may be obtained from the secondary crop cultivated in between the planting and fruiting time, as well as the prices obtained from the fibre extracted.

In the first year the return is always poorer than the succeeding crops, but in the first year inter-cropping is the common practice, (which however is not practicable where the intervening distance is less than what has been indicated earlier) and it yields some profit. In the first year more than 300 bunches may be obtained, which is doubled or trebled in the succeeding years, as there will be three suckers of different ages left in the stool, after cutting down the parent plant after harvest. The average market price for each bunch is near about Rs. 2.

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[8] Wardlaw, C. W. (1947). *Nature*, **160** (4064), 405.

[9] Ocfemia and Cartimisan (1928). *Phytopath.* **XVIII**, 10.

[10] Guha, M. P. (1948) Banana—the fig of paradise. *Modern Review* (April), 1948, 299-203.

There is a wide variation in the distance at which bananas are planted in India. As close spacing always leads to almost total exhaustion of the soil, it is better and wiser to make the intervening spaces wider which ultimately give better result in quality, size and quantity of the yield.

Marketing

Of the total production of 109,841,000 maunds estimated in 1940-41 (loc. cit. 2), the total available in the market was 87,087,000 maunds, the rest being retained by the producer for home consumption. The annual wastage has been estimated at 1,532,400 maunds and out of the rest a little more than 14 per cent is utilized for cooking, a little more than 85 per cent utilized for table purposes and less than 1 per cent for industrial purposes.

On account of the perishable nature of the fruit, banana requires special handling and the fruit must be cut at a stage of maturity adapted to the length of the journey, and in case of longer journeys, special provision for cool chambers are necessary. According to Wardlaw and McGuire[11] a storage temperature of 54°F. is generally aimed at during transportation. Sometimes the stem end of the bunch is smeared with vaseline or melted paraffin to check diseases, and to keep the fruits fresh for a longer time. The special adaptability of the Champa variety, which stands longer journeys well without special care, has led to its extended cultivation in Northern and Eastern India. The best provincial varieties are generally limited to even a district due to their soft peel, which requires special methods of crating.

Banana is the only fruit of importance which is available in the market throughout the year, although there is seasonal variation in supply as shown in Fig. 5.

Economic aspect

Fibres extracted from banana closely resembles that of *M. textilis* (popular as Manila hemp), although not so strong. Wild varieties should be explored for extraction of fibre. Sarker[12] gives a long list of articles that can be manufactured with the fibre, such as rope, twine, chord, nets, bagging, sacking, matting, carpeting, lace, plaits, braids and even handkerchief. Even the coarsest fibre can be utilized for paper-making and the rejected tow for packing and stuffing purpose. The only difficulty is the expense of transporting to the factory, which, however, can be overcome in case of large plantations, where this industry may develop as a by-product. The dried, powdered and sifted flesh of the fruit (banana or plantain meal) should preferably be manufactured from mature but unripe fruits, as the starch changes into sugar during the ripening process. Essences and *attars* may be prepared from ripe bananas though synthetic products might be cheaper. Alcohol can also be manufactured. Jams, jellies and marmalades can be manufactured with profit. *Kshar* is prepared by burning dried leaf sheaths of banana or plantain plant and this detergent, which is equal in action to washing soda, is being utilized by our village people, for washing their clothes by boiling from times immemorial.

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[11] Wardlaw, C. W. and McGuire, L. P. (1931). Bananas, Publ. No. 35, Emp. Markt. Board, Lond.

[12] Sarker, J. K., (1917). *Handbook of Plantain Fibre and Fruit Industry*, 10.

A BRIEF REVIEW OF BRITISH AGRICULTURE DURING THE LAST WAR

By S. K. ROY

MOST parts of Great Britain were not considered suitable for arable crop farming. Not unnaturally, therefore, between the two great wars when imported foodgrains were very cheap, farmers unable to compete with the foreign markets, concentrated mainly on dairy and livestock farming. Most of the farmers depended on permanent pasture or long leas for rough grazing and hay for their livestock, supplemented by roots which were grown in small areas. Almost the whole of the concentrated food for their livestock was purchased from abroad.

The outbreak of war in 1939 deprived her of the produce of vast areas of land overseas; imports of grains and concentrates for cattle food were very much reduced. It became absolutely necessary to increase her production of grain, potatoes, and beet. With new knowledge and new facilities, the tractor, cheap and effective fertilizers, new and improved strains of crops and of grasses and clovers, all these demanded altered systems of farming if the land of this country had to be turned to the best national use, to the best economic advantage to the farmer. The main drawback to this extension lay in the fact that such extension reduced the area of cow-keep, just when the latter was most needed.

Potato growing

Potato growing has for a long time been a feature of farming in this country. It would seem that its extension should have presented no great difficulty, but it caused difficulties out of all proportion to the area involved. Of all farm crops it demands the greatest amount of labour, and the increase was called for in a period of acute labour shortage. It is a crop on which only men equipped for its cultivation can make money, while new-comers to the industry will lose money. The required increase could not be obtained only from the well equipped farmers—the quota had to be shared out among all farmers, experienced and inexperienced alike, who had land in anyway suitable. Wheat presented less difficulty as a crop.

Land reclamation

A survey was at once instituted by each County Executive Committee to discover what land in an unproductive state could be turned into account. Marshy land was drained by deep ditches and pumps were installed; pipe drainage and cultivation followed. Such land previously lying under indifferent grass, though difficult of cultivation, proved very fertile.

No doubt some of these adventures were very spectacular but taken as a whole these were too limited in scope to affect the gross output of the country very much. The total gains amounted to less than the losses to the defence services for aerodromes, camps and depots. The main contribution to the national output had necessarily to come by way of general improvement in farming technique. The Executive Committee worked therefore to find out every farm grassland suitable for ploughing.

Cultivation by contract

The implement shortage was eased by the development of the practice of cultivation by contract. A large number of small firms of agricultural contractors, equipped with tractor tools, sprang into existence, and if their initial skill left something to be desired, they learned their job quickly.

Ploughing-up and cultivation of old turf

The first impetus to a movement that had already started was the declaration of £2 (Rs. 27) subsidy per acre by the Government in 1939 for the plough-up campaign. Emergency fertility was the immediate aim, but a farmer could not create emergency fertility without doing something that would have an enduring influence on his farm, and therefore on his methods of husbandry; and this, though a secondary effect of the subsidy, was really its greatest strength. Because of this secondary influence, the £2, supported by the lime and slag rebates, constituted a generous State aid to land improvement—an aid that

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every far-seeing farmer availed of, emergency or no emergency. To the farmer himself the enduring aspect of the subsidy was of more importance than its emergency aspect.

The first crops

The first crops were commonly oats or wheat. There were comparatively few failures. In the beginning, yields were high while weeds, though generally increasing, were kept in check. But as the war progressed and more old pastures were brought under the plough, it became increasingly difficult to find fields suitable for ploughing. Pipe drains silted up rapidly and many fields, though under-drained, became too wet for successful cultivation owing to the condition of the pipes. Many fields which were dry enough for cultivation when first ploughed out became sticky and difficult after the turf had rotted. Farmers had, therefore, often to risk cultivation on indifferently drained and difficult land. Taken as a whole, however, cultivation of old turf was entirely justified by results.

Regular rotation

By the end of 1943, the total area of grass, both permanent and temporary, had been reduced to below 1½ acres per cow equivalent. The time came for seeding down again. The process of bringing the enlarged area of arable land into something like regular rotation then commenced. Much land had to be seeded down without passing through a year under cleaning crop. On the wetter soils preliminary half-fallows had to be invoked. The practice of seeding without a cover crop proved very satisfactory. By various means a balance of tillage crops and lea was gradually established. The arable land of the country could now fairly be described as under a six-course rotation, with four years of tillage crops and two of lea.

Herd management

During this period, however, there was no change in the country's cattle stocks. In fact, numbers rose slightly towards the end of the war. In 1942, the Executive Committee launched a programme of herd improvement because much cross-breeding and purchase of nondescript cattle had been practised. A drive for higher yields and a greater proportion of winter milk was instituted by survey, and verbal, written and visual appeal. The approach to improved breeding was advocated, firstly, by the use of sires of known milking ancestry and, secondly, by the insistence on continuity in breeding policy. Sires of any particular breed, however, was not insisted though the desirability of adopting one breed, and sticking to it when adopted, was stressed. Since good records of sires of dairy breeds were more easily obtainable than those of dual purpose type, Ayrshires and Friesians increased rapidly. The demand for bulls from milk recorded stock increased. The propaganda had immediate effect.

In the analysis of costs and benefits, the technique for measuring improvements is inadequate for calculating the cost of agricultural improvement works for three major reasons. It seldom takes into consideration : first, multiple uses and benefits ; second, intangible uses and benefits that cannot be measured in terms of money and sold ; and third, costs or losses that are being experienced and will continue to be experienced if the contemplated measures of improvements are not pursued.

The net results of agricultural improvements in Great Britain, during the last war may, however, be summed up as follows: Six million acres of old turf were ploughed and cropped, the arable area was increased by more than one-third, and the tillage area increased by half. The production of cereals was increased by sixty-six per cent, potatoes by eighty per cent, and vegetables by eighty-eight per cent.

WIND EROSION AND ITS CURE

By S. ATTAR SINGH

THE removal of soil is called erosion. It is caused by wind and water. The latter of course, is the most damaging factor in the Punjab.

What is wind erosion

It is sand blown by dry, hot, strong and fast winds and deposited on cultivable fertile land, which reduces its fertility and thereby renders it unfit for further cultivation.

The removal of soil particles by wind is a less noticeable phenomenon than gullying by water erosion but it is nevertheless of considerable importance in some of the lands of the Punjab. Wind blown sand tends to form a special landscape of long flat stretches broken by hummocks with bush growth on top of them and wind channels hollowed out all round the miniature hills. Where level plains of grassland have been too heavily grazed the grass tends to disappear and be replaced by deep rooted bushes round which the wind generally builds up sand dunes. Such dunes menace neighbouring fields and pastures because any storm may drive the sand on to them and cover them.

Duststorms are proverbial in the southern part of the province and are a scourge to the local inhabitants. A vast stretch of the country has been buried in sand, and on its outskirts the drifting sands gradually encroach on the neighbouring land and render it unculturable in time. The dry hot winds blowing from this tract prove detrimental to field crops on account of their desiccating effect.

There is no doubt that severe wind erosion is going on and that in some regions it is definitely on the increase. Survey records of 1870 and 1935 show desert increase brought out by conditions on the ground. Not only is there a general movement of sand from south-west to north east across the plains in all the southern districts of the East Punjab, except where irrigation is established, but there is a much local increase of sand drifts and dunes extending eastward out of the main shallow drainage channels throughout the districts of Ambala, Jullundur, Karnal and the States of Patiala and Faridkot. It is only after a fairly accurate location of such conditions that we can attempt to plan in detail our desert-fringe conservation measures. Figures on sand-storm damage are not available and probably never will be. It is a case of judgment and vision rather than statistics.

The contributory factors

Bare fields, dry soil, and high wind, and an unobstructed sweep for the wind are the four factors which contribute to the severity of a sand-storm.

Everyone must be familiar with the tragic tale of the America's 'Dust Bowl' where ill-considered ploughing of natural grasslands and failure to provide shelter-belts in a hot wind-swept country, somewhat similar to the Southern Punjab, led to wind erosion. The plough destroyed the grass sod, which, with its mat of roots, had bound the light powdry soil for centuries; the soil thus exposed became the plaything of the winds and millions of acres of land went out of cultivation. The resulting poverty and suffering have been ameliorated to some extent by the Federal Government's action in planting a vast number of narrow shelter-belts along field borders, roads, railways and waste lands to form a defence against the prevailing wind. Unless some similar project is worked out for our desert-fringe districts of Gurgaon, Hissar, Sirsa, Ferozepur, Fazilka increasing poverty and aridity in this already treeless tract will be unavoidable.

Control of wind erosion

The same principle holds for wind erosion as for water erosion. Sand dunes form only when the natural plant cover has been thinned out or destroyed through misuse and the obvious way to prevent sand blowing is to keep plenty of shelter-belts and wind breaks of tall grasses, bushes and tree-growths, to prevent cattle from destroying the natural grasslands and to keep a good proportion of field

S. ATTAR SINGH is Forest Publicity Range Officer in the East Punjab.

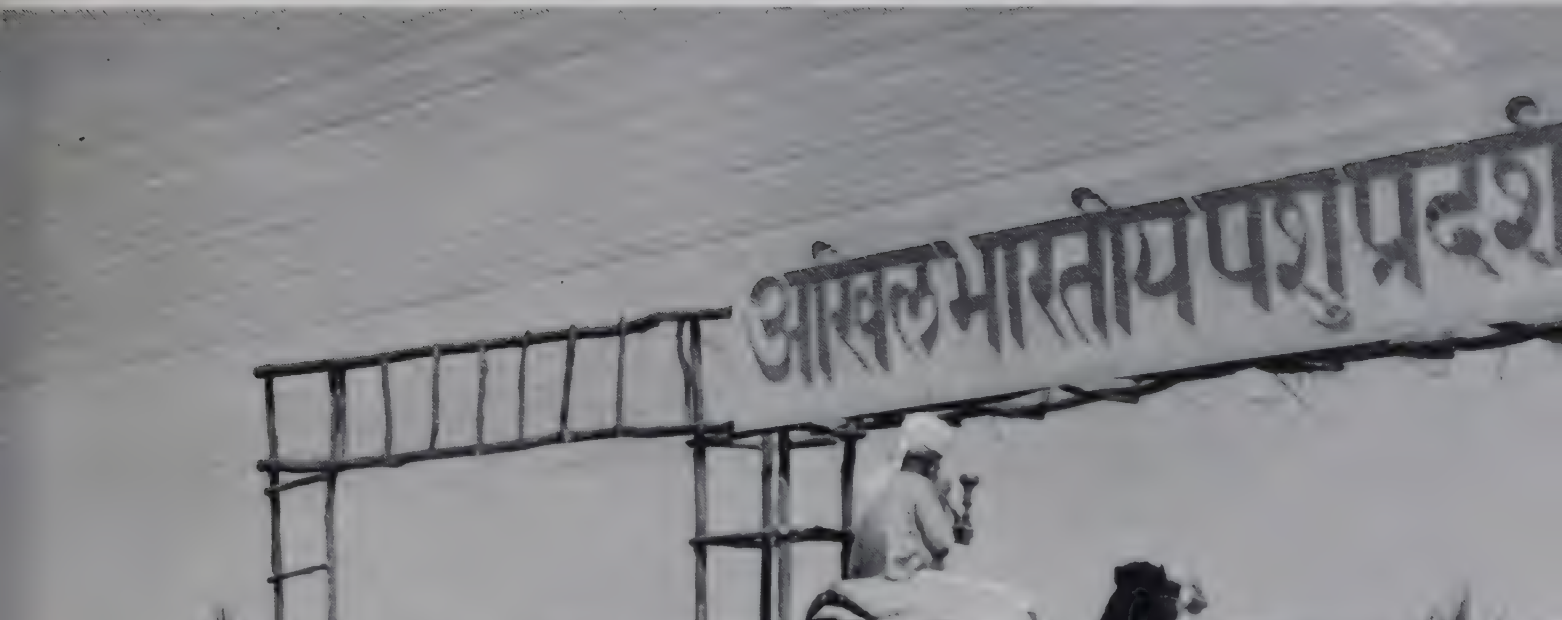
crops in dense strips at right angles to the prevailing wind. This type of work is very badly needed throughout Rohtak, Hissar and Sirsa areas.

To stop the strong winds and to act as obstacles and barriers in their passage, trees are usually planted in one or two or three rows; such rows of trees are called wind belts. These belts should make right angles with the direction of winds and the distance from one belt to another should be half a furlong to one furlong. Each belt will be effective on an area ten times in length of the average height of the trees. The tall trees should be planted in the middle row and on both of its sides only hedges or bushes should be planted. But the ideal form of shelter-belts to break the force of desiccating summer west wind is probably to grow agaves on the outer and lower fringe then cane grass and shrubs leading up to high trees in the rear.

Afforestation need not necessarily be with timber trees and much of the desert fringe in its present conditions simply will not allow them to grow. We can, however, do a great deal with giant cane grasses (*Saccharum munj* and *S. spontaneum*) which have previously been treated as weeds in the Punjab. The series of wind breaks, as already pointed out, must be established at right angles to the wind. Another important point is that *watts* should be constructed around wind-belts so that rain water could collect and get absorbed then and there, as because of rain shortage the trees in the Southern Punjab do not grow to their full height.

These shelter-belts have been successfully used in foreign countries to check wind erosion. The landes of France and the sand dunes of Palestine are conspicuous examples of what can be achieved in the way of land reclamation and control of sand drifts by planting trees.

Therefore, one of the most important activities of the East Punjab Forest Department is to establish these wind breaks and shelter-belts in appropriate areas. Individual farmers are discouraged by such a long term programme or may be deterred by lack of funds, or may not have inclination or the necessary foresight, knowledge and experience to take interest in such activities. The greatest possible inducement should, therefore, be offered to individual farmers to undertake the job.


अखिल भारतीय पशु प्रदर्श

Gateway of the Eighth All-India Cattle Show

THARPARKAR

The Hon'ble Minister for Food and Agriculture (centre) at the Eighth All-India Cattle Show along with membe of the Committee ; on his right is Sardar Datar Singh, Vice-President of the Committee and on the left are Mr. P. Nanda, Animal Husbandry Commissioner with the Government of India and Mr. M. R. Sharma, Secretary of t Committee.

EIGHTH ALL-INDIA CATTLE SHOW

By M. R. SHARMA

THE All-India Cattle Show, an event of great importance in India's capital was held at Raj Ghat which is now well known throughout the world as a place of pilgrimage. Held in the open space adjoining Raj Ghat where the cherished memory of the father of the nation is enshrined, the show could not have a better location for the realization of its objects of fostering the development of Indian cattle. It was a coincidence that the All-India Cattle Show and the Gandhi Mandap Exhibition were in progress simultaneously at Raj Ghat and were centres of great attraction. There was a record rush of visitors to the Show at all hours of the day. The increasing number of visitors both from rural and urban areas is an evidence of the growing public interest in the development of the cattle wealth of the country.

The All-India Cattle Show, held from 27 February to 4 March, 1949 was opened by the Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture and President of the All-India Cattle Show Committee. The Fifth All-India Poultry Show was also held in conjunction with the All-India Cattle Show from 2 to 4 March, 1949.

Importance of cattle shows

Sardar Datar Singh, Vice-President, All-India Cattle Show Committee, welcoming the Hon'ble Minister emphasized the importance of cattle shows in developing the livestock of the country. He hoped that with the continued interest and cooperation of the Provinces and States and with an increased grant from the Centre, the Committee would overcome the obstacles which stood in the way of fulfilment of its objects. Some of the best breeds in the country, he said, had gone to Pakistan as a result of the division of the country. The need for developing our own breeds was, therefore, greater and could be done by fostering a spirit of competition amongst our breeders and giving them every encouragement possible.

M. R. SHARMA is Secretary to the All-India Cattle Show Committee.

The Hon'ble Minister for Food and Agriculture inaugurating the Eighth All-India Cattle Show, which was attended among others by diplomatic representatives including the Ambassadors of the U.S.S.R. and China, Members of the Constituent Assembly and officials of the Central and Provincial Governments, complimented the All-India Cattle Show Committee on its efforts during the last ten years to improve livestock in India. He said that the gap between the effort and the ultimate aim was still large. He suggested that an extensive organization was necessary so as to reach the homes of millions of farmers who were directly interested. Efficient bullock power was essential for India's effort to increase food and agricultural production. He asked villagers and farmers to co-operate in this great national effort and emphasized the need of improving the breeds of cattle in India, if the country's economy was to be organized on sounder lines. He suggested that efforts should be made to organize from next year a cattle competition for every group of 20 villages in the country, and fixed January 30 as a national day when every village in India could participate in these competitions.

Entries received

Entries were received for 531 animals reresenting 21 important breeds of cattle, buffaloes, sheep and goats; Dangi from Bombay Province, Deoni from Hyderabad-Deccan, Gir from Junagadh and Ajmer, Hariana from the East Punjab, the U.P., Orissa and Delhi; Hissar from the East Punjab, Delhi and the U.P., Khillari from Bombay Province, Malvi from Madhya Bharat; Nagori from Jodhpur; Nimari from Bombay, Rath from Delhi Pinjrapole, Red Sindhi from Jubbulpore, Bangalore and Allahabad, Sahiwal from New Delhi, Patiala and Meerut, Tharparkar from Karnal, and Jubbulpore, Ponwar from the U.P., Mewati from the U.P., Murrah buffaloes and Nili/Ravi from the East Punjab, Jamnapari and Barbari goats from the U.P., Betal goats and Bikaneri sheep from the East Punjab.

Ongole and Kangayam, the famous breeds of Madras, and Kankrej from Bombay were conspicuous by their absence, the former due to transport difficulties and the latter owing to famine conditions in Gujarat. The total number of poultry birds exhibited was about 300. Though the organization is still called the All-India Cattle Show, it includes sheep, goats and poultry which are also of .great importance in the economy of India. The exhibits generally were of a higher standard and the competition in most of the classes was keen. The show provided a common platform for breeders and officials engaged in the development of cattle to meet, discuss and exchange ideas on the subject of breeding livestock of this vast sub-continent.

Prize distribution

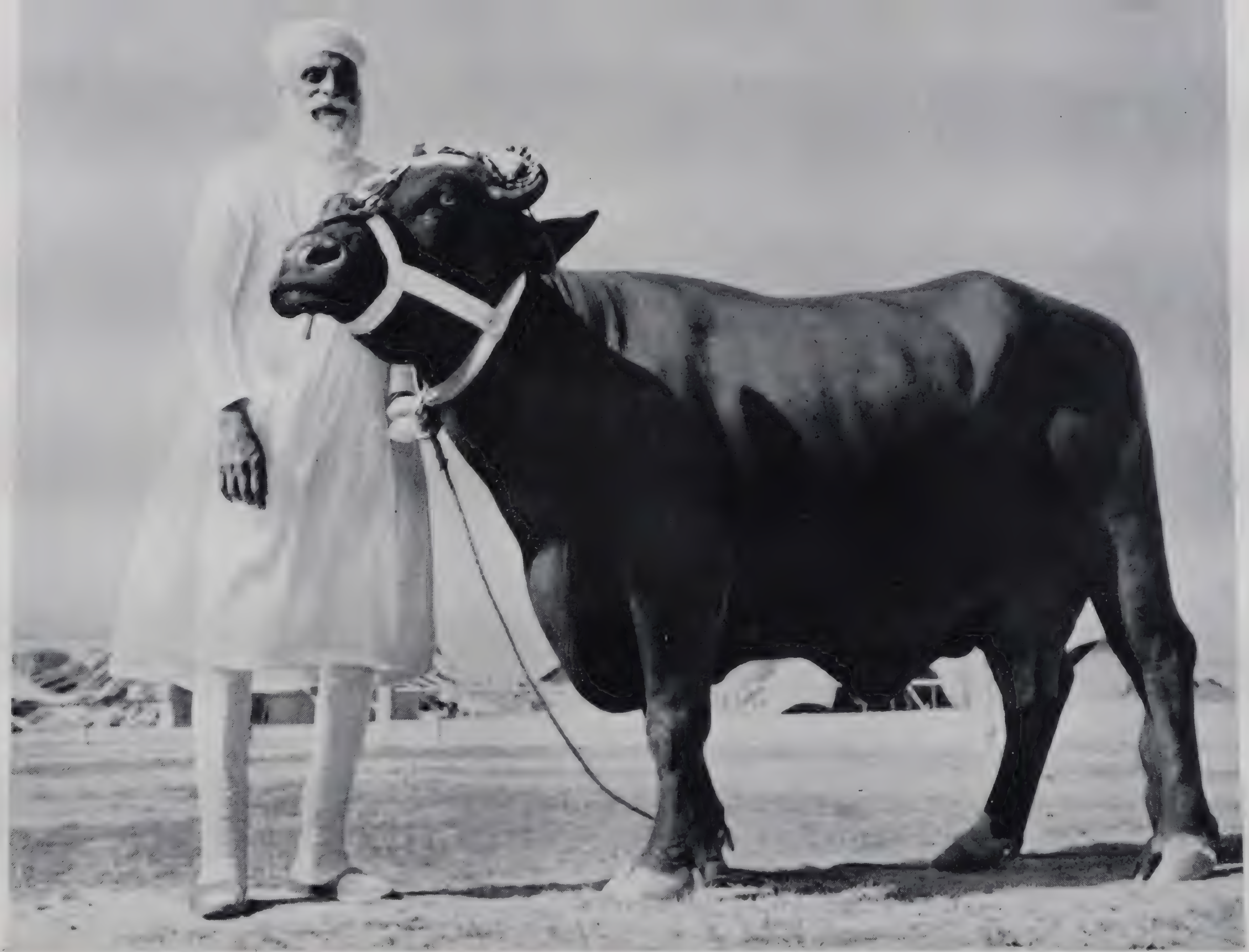
The Prize Distribution was held on 4 March, 1949 by the Hon'ble Shri Jairamdas Daulatram. His Excellency the Governor-General, Shri C. Rajagopalachari, who was to distribute prizes could not attend owing to indisposition, and sent a personal message to Sardar Datar Singh, Vice-President, in which he said: 'I am very sorry to be guilty of ill-health and of a breach of promise in consequence. I send this apology for my absence at the eighth annual show of the organization that has been rendering very useful service in animal husbandry. It is well to remember that the doctrine of non-killing and compassion will not alone improve our cattle. Well-planned and deliberate steps must be taken if we desire to possess good draught bulls and milk-yielding cows, and not animals that are a charge on our pasture and fodder crops, without being either happy themselves or contributing to human happiness. Even in the times of Valmiki, men knew the difference between good breeds and bad breeds of horses and other animals. A people, who saw good in the caste system, could not fail to see the advantage of careful animal husbandry. We have a great deal to learn from other countries as to how to plan and progress in our animal production'.

Sardar Datar Singh welcoming the Minister for Food and Agriculture said that public enthusiasm for the Show had been increasing. As compared to the number of entries received at the last Show, the entires this year were encouraging and the number of exhibition stalls was almost twice last year's number. It was revealed that the All-India Cattle Show Committee have decided that in future the All-India Cattle Show will be held at different places in the country so that people from all parts could participate in increasing number. A large and distinguished gathering which included members of the diplomatic corps, members of the Parliament, press correspondents and officials and non-officials, witnessed the prize distribution by the Hon'ble Minister for Food and Agriculture. In keeping with the practice in the past the first prize-winning animals were marched passed as the Prizes were awarded and a running commentary was given simultaneously on the loud-speakers giving details of the prize-winning animals, their habitat, distribution, merits, etc. This provided the audience with an opportunity of seeing improvements which have been affected by the stimulus the All-India Cattle Shows have given in the direction of breeding better types of cattle. It is not possible to see such a representative collection of cream of India's cattle together at any one place except at the All-India Cattle Show. Cash prizes for the Cattle Section amounted to Rs. 6,580 and in addition about 55 trophies valued approximately at Rs. 55,000 were awarded. The most coveted prize for the best animal in the Show was won by a Nili/Ravi buffalo cow belonging to H.H. Pratap Singh Ji Maharaj which was adjudged as the best animal of this year's Show and won a number of cups and cash prizes.

In the Poultry Section prizes amounting to Rs. 730 were awarded in addition to 20 Challenge Cups. Sardar Jagat Singh of the Kingsway Poultry Farm, Delhi, won H.E. the Governor-General's Silver Plaque for the best bird in the Show with his Rhode Island Cockerel which also won many other prizes.

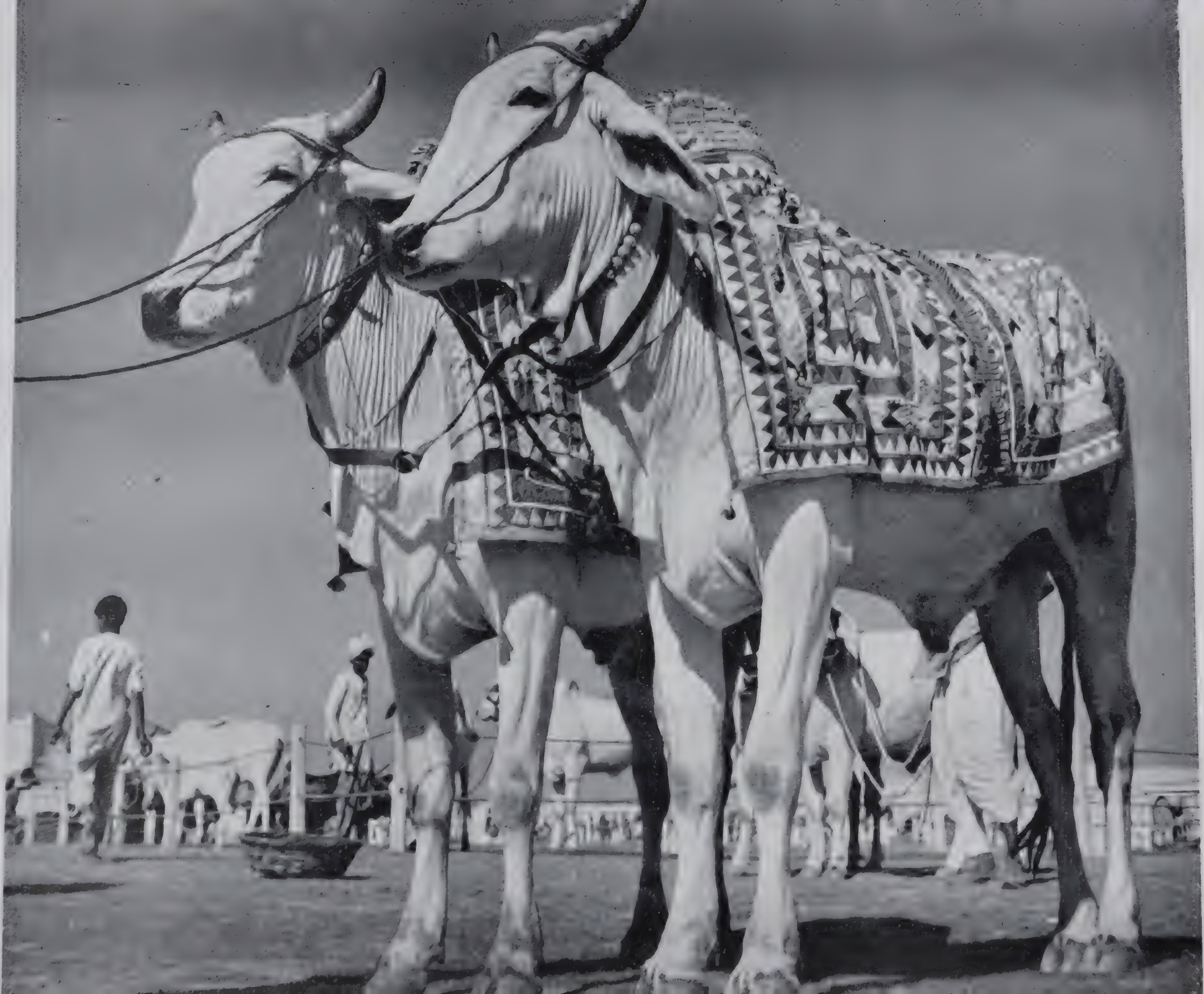
Milk-yield competition

One of the other important events of the Show was the milk-yield competition which elicited keen interest and was designed to stimulate milk production. Whereas the highest milk-yield record at the Show was 38 lb. in 1947 and 30 lb. 12 oz. in 1948, this year it was 41 lb. 2 oz. in 24 hours. A Sahiwal cow belonging to the Indian Agricultural Research Institute, New Delhi, annexed the first prize for the highest milk-yielding animal in the Show. The Indian Dairy Research



'Lajjo', a buffalo of Nili/Ravi breed owned by His Holiness Shri Satguru Pratap Singhji Maharaj of Gurdwara Bhaini Sahib, Ludhiana, was declared the best animal in the All-India Cattle Show. She was also declared the best buffalo cow in the Show.—P.I.B.

PLATE 43



Institute, Bangalore, got the award for the highest milk-yielding Red Sindhi cow.

A Students' Judging Contest is organized every year to train students in the art of judging cattle. It was held on the opening day of the Show. Seven teams from the various colleges and institutions in India entered the competition which was the object of enthusiasm and keen interest not only for those who formed the teams but also for those who had come as spectators. The team entered by the Indian Veterinary Research Institute, Izatnagar, stood first and won Rs. 75 and a shield presented by Messrs. Polson Ltd., Bombay, for this contest. The second prize of Rs. 60 was won by the team of the Indian Dairy Research Institute, Bangalore.

Sale of cattle

The auction sale of cattle attracted a large number of entries. The auction was conducted in one of the judging rings on 3 March 1949 and Mr. P. N. Nanda, Animal Husbandry Commissioner with the Government of India and Chairman, Executive Committee, All-India Cattle Show Committee, presided. The highest price, viz. Rs. 750 was fetched by a Hariana young bull owned by Ch. Pratap of Rohtak. There was a great demand for Hariana cattle. Other animals sold at the auction sale also fetched good prices, which are otherwise not possible for the breeders to obtain for their animals.

Breeders' conference

The other notable feature of the Show was the Second All-India Cattle Breeders' Conference which was convened on this occasion. Breeders from all over the country met in a three-day session. The Vice-President, All-India Cattle Show Committee in his presidential address stressed the need for developing such breeds as Red Sindhi, Tharparkar and Sahiwal as these have gone over to Pakistan. The conference passed a number of resolutions urging the Government of India to arrange for the multiplication of the breeds lost to India due to partition, development of dual purpose breeds, restriction of the sale and export of animals from their home tracts and to formulate a definite policy for the improvement of cattle in all the provinces and States. The conference also recommended the 'Key Village' Scheme to be adopted for the development of livestock and suggested that lands should be given to breeders for cattle-breeding on certain conditions.

The conference, which was attended by delegates from Bombay, the U.P., the East Punjab, Madras, Mysore, Coorg, Hyderabad, the C.P. and Berar, Rajputana, Madhya Bharat, Kashmir and Travancore, also decided to organize cattle shows all over India with the ultimate aim of arranging one show for every 20 villages every year. It was further decided to approach the Government of India for special funds for the All-India Cattle Show Committee.

Exhibition stalls

A remarkable feature was the large number of exhibition stalls at the Show which attracted large crowds. The stalls were well decorated and imparted useful knowledge in the sphere of agriculture in general and Animal Husbandry in particular. A noteworthy feature of this year's Show was that most of the charts and illustrations had explanatory notes in Hindi. The villagers, who in the past were deprived of information contained in these charts and illustrations, as English was used therein, paid special attention to these and took full advantage of this opportunity to learn the results of research in scientific and systematic cattle-breeding.

The All-India Cattle Show which is becoming more and more popular drew large crowds at all hours of the day both from urban and rural areas. Vast propaganda was carried out through posters, hand-bills and broadcasts, particularly by the inclusion of items on cattle show in the rural programmes. The proceedings of the Show were filmed and the All-India Radio arranged for the broadcast of the special features and results of judging on a number of occasions. The All-India Cattle Show Committee also published a revised edition of the pamphlet entitled *The Role of Livestock in the Economy of India* for which there was a great demand.

A cinema show on cattle shows and development of agriculture in foreign countries, with special reference to their application in this country, was also arranged at the instance of the Hon'ble Minister for Food and Agriculture.

About 100 villagers from the adjoining villages took advantage of this opportunity of seeing the film a running commentary on which was given in Hindi.

The prize distribution was witnessed by over ten thousands people. Photographs of the important events and of prize-winners at the Show were taken. The expanded activities of the All-India Cattle Show Committee and the special features noted earlier designed to stimulate the breeding and development of Indian cattle added considerably to the importance of this Show. Finally it may be said that the All-India Cattle Show was a great success.

CONTROLLING FLIES WITH B.H.C.

LABORATORY and field studies have shown that the primary cause for failures of DDT residual sprays to accomplish satisfactory fly control in Southern California areas during 1948 has been the development of fly resistance to DDT and related materials. This resistance to DDT has developed to such a magnitude in some of the fly strains collected in the field, that it is virtually impossible to obtain 100 per cent knockdown and kill of the flies by means of residual DDT spray treatments.

Field studies have shown that benzene hexachloride appears to be the most satisfactory material of those tested for the replacement of DDT in residual sprays in dairies and comparable outdoor situations. This material used at 17 pounds of a 12 per cent gamma isomer wettable powder in 100 gallons of spray (approximately 0·25 per cent gamma isomer) accomplished effective control for three weeks to one month during the hottest summer weather and up to two months during the cooler fall weather.—*Imperial Chemical Industries, Technical Service Department Report* No. GCS/PC/116.

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This bull of Hissar breed belonging to the Government Livestock Farm, Hissar, was declared the best bull in the All-India Cattle Show. Its age is four years and eight months.—P.I.B.

LATE BLIGHT OF POTATOES IN THE PLAINS

By R. S. VASUDEVA and R. N. AZAD

IT is well known that late blight of potato caused by *Phytophthora infestans* (Mont) de Bary is common in the hills and occurs rarely in the plains of India. The disease is characterized by the presence of small, irregular, brown lesions, mostly towards the margins and tips, on the upper surface of the leaves. In favourable weather the lesions rapidly increase in size, turn black and wet rot sets in resulting in a pronounced smell of decaying organic matter. In severe cases stems and tubers are also affected. The causal organism is extremely sensitive and cannot withstand high summer temperatures that prevail in the plains. The disease was first observed in the plains of Bengal, Assam and Bihar in 1889-1900, 1912-13 and 1913 respectively. In the plains of the U.P. it was observed for the first time in 1943 at Meerut and Dehra Dun in potato crop of the variety Gola, seeds of which had been obtained from the hills.

Late blight in the plains of the U.P. has again been observed in 1948 in Gola and Phulwa varieties. Natural infection in Phulwa variety in the plains has been observed for the first time. During the course of survey of potato crop in the plains of the U.P. and Bihar in February-March, 1948, late blight was observed at Hapur (U.P.) in a few fields of potato crop raised from Phulwa seeds obtained from Patna and also in the crop raised from seeds stored in Meerut Cold Store. The infected plants exhibited typical symptoms of the disease. An average incidence of 15·5 per cent in Phulwa potato crop raised from the Patna seed material and 28·25 per cent in the crop from the local seed was recorded at Hapur in the last week of February, 1948. The second Gola crop, the seed of which is imported from the hills every year at the time of planting during December, was also found to be infected with late blight and an average incidence of 50 per cent was recorded in the end of February, 1948. By the end of March, this crop had been devastated by the disease.

Late blight of potato has so far been recorded in the plains only in the crop raised from the seed which is imported from the hills at the planting time and is not exposed to high summer temperature in the plains. The appearance of late blight in the Phulwa potato crop, the seed of which has continuously remained in the plains, is a case of secondary infection from the infected second Gola crop planted in December-January. In this connection it is to be noted that there was a very severe attack of late blight in the hills during 1947 and the seed imported from the hills obviously carried the infection. Moreover, the weather conditions during January-February, 1948, in Meerut and Hapur areas have been favourable for the development and spread of the disease.

R. S. VASUDEVA and R. N. AZAD belong to the Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi.

ADVANTAGES OF WASHING WOOL BEFORE SHEARING AND GRADING

MOST of the wool in the Indian markets is sold unwashed because of the reluctance of the shepherds to wash the sheep before shearing, as in many cases he cannot get extra return for his labour. In fact, in many places some sand or dust is mixed with wool to increase its weight, on account of its being sold on weight basis. There is no proper grading of wool and the wool from the different parts of the body is mixed and sold as such. To demonstrate the advantages of washing before shearing and grading of wool, the Indian Council of Agricultural Research has worked a scheme in Ajmer, an area where wool forms an important commercial commodity.

This scheme has been recently completed and has given very encouraging results. The main object of the scheme was to demonstrate to the shepherds as to how by washing and proper grading of wool he could get extra money for his wool. It was no easy task to persuade the shepherd to adopt new methods and give up the primitive methods and implements. To achieve this, a number of supervisors were appointed and were given necessary training. Well in advance of the shearing season, the names of stock-owners were registered together with the number of sheep. The cooperation of the village *lumberdars*, *patwaris* and staff of the Cooperative Department was also sought in the matter. Necessary arrangements for demonstrating the process of washing, shearing, grading, storing, and transporting the produce were made. The system of payment of an advance premium at 6 pies per sheep was introduced to attract the villagers to offer their sheep for the experiment. The sheep were washed 3 to 4 days before shearing so that all the wool produced was clean. The wool was graded into white wool and coloured wool. The graded wool from all the areas was transported to Beawar, the second biggest wool market in India, and the representatives of the flock-owners were taken there to watch the open auction. The sale proceeds were distributed to flock-owners. It was found that the graded and properly washed wool fetched Rs. 20 to Rs. 30 more than the usual price per bale. The profit per sheep in this manner came to about 1 anna 9 pies per sheep, which, though a small amount, helped the shepherd considerably to adopt the improved method of grading and washing of wool before shearing. This experiment has, thus, conclusively proved that it is decidedly more profitable for the flock-owners to undertake washing and grading and that there is ample scope for improvement in the quality of wool. There is no doubt that in the beginning this can be done well only with the help of the Government. (I.C.A.R.)

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Can you let me know a cottage scale method of dehydrating potatoes and oblige.

A. 1. *Raw material:* Potatoes of large size, free from disease and fully ripe, with the least possible number of eyes, are selected.

2. *Washing:* They are thoroughly washed in running water to remove dirt and other sticking matter.

3. *Peeling and trimming:* These operations are done by hand. Peeling of washed tubers may either be done by means of sharp stainless steel knife or by means of *sippis*. Peeling with *sippis* gives better results but is rather costly. Eyes and any other damaged portion should be removed carefully, care being taken that after peeling and trimming the potatoes are kept immersed in water.

4. *Slicing:* Peeled potatoes are sliced about 3/6 in. thick in ordinary fodder cutter type slicer with adjustment to cut slices of desired thickness. These slices of potatoes are immediately put in stainless steel tanks containing cold water. But when the slices have to wait 5 to 6 hours before putting into the dehydrator they are placed in 0·05 per cent potassium meta-bisulphite solution to avoid blackening and spoilage.

5. *Blanching:* The prepared slices are then put in small lots of about 15 lb. in a perforated galvanized iron bucket, which is placed in boiling water in an open galvanized iron tank heated on direct fire. The bucket is constantly stirred and the temperature of the water is not allowed to go below 190°F. till the slices are properly blanched. The bucket containing the blanched potato slices is then dipped in cold running water.

6. *Dehydration:* The prepared slices are put in single layer on wire gauze (1/8 in. mesh) trays, 1 sq. ft. containing about 1 to 1¼ lb. of slices. The trays are then put in the home drier (description given below) or loaded on a trolly which is pushed in the tunnel type dehydrator at its cold end. The door of the dehydrator (temperature at cold end 140 to 145° F. and at the hot end 170 to 180° F.) is then closed air tight. After 2½ hours a second loaded trolly is rolled in and the tunnel again closed air tight. The process is repeated for the third trolly also. After 2½ hours after the third trolly has gone in, the first trolly is ready to be taken out at the hot end with dried potato slices and another trolly freshly loaded is put in through the cold end. In this way the process becomes a continuous one. Thus after every 2½ hours one trolly with dried slices is taken out and freshly loaded trolly is put in at the cold end.

During the process air is forced in with a fan put at the top of cold end and temperature and humidity are controlled with the help of side dampers.

Temperature at the cold end : 140 to 145°F.
Temperature at the hot end : 160 to 165°F.
Humidity at the cold end : 40 to 45 per cent
Humidity at the hot end : 20 to 25 per cent

The home drier consists of a strong galvanized iron sheet box 3ft. × 2ft. × 3ft. with a strong perforated iron sheet bottom. The sides and top of this box are enclosed in a wooden frame work and the box is supported on an iron stand 1½ ft. high. Heat is applied by placing *angethi* below the perforated bottom. The drier has slits 2 ft. × 1·5 in. along the length on both sides about 4 in. below the top to let off moisture. The slits have adjustable flaps which can be opened and closed to regulate the flow of overporating moisture. This drier can accommodate seven trays, 2¾ft. × 2ft. in size.

What's doing in All-India

ASSAM

H. NAG-CHAUDHURI

THE milk consumption *per capita* in India is very low in comparison to that of the other countries in the world. Within India, it is the lowest in Assam since the average milk yield per cow in this province is less than that in any other part of India. The soil condition of the plain districts of Assam is such that any lapse in hygienic and sanitary measures exposes the livestock to various infections, which, though curable by treatment, are enough to reduce the vitality of the affected animals. And with our rural people, ignorant and circumstanced as they are, such lapses are very common. The milk consumption in Assam, therefore, is still on the downward grade in spite of very many enterprises made by the people from time to time.

But Shillong, the capital of Assam, simulates the natural condition of some of the homelands of the best dairy cows of foreign countries. It thus affords a rare opportunity to develop its dairy with cows which are suited to such climatic conditions.

Dairy development in Shillong

After a preliminary study, Shillong was found to possess the requirements for proper upkeep of foreign cows. The pioneer efforts in this respect were made by some Englishmen, who brought a few English cows and proved that these cows could thrive here fairly well. The Livestock Department of the Assam Government then brought in Ayrshire and British Fresian cows and a bull in their Cattle Farm at Upper Shillong. This move not only effected an immediate increase in the milk yield in the farm and thereby made it possible to supply milk to increased number of customers, but it also gave a very good opportunity to the public of Shillong to improve their livestock. The public availed of this opportunity. People are allowed to purchase the surplus stock of cows and heifers of the farm and to have their cows served at the farm by the farm bulls at a nominal fee. One now finds in Shillong cows of Fresian and Ayrshire character everywhere.

The high milk yield per cow of these breeds induced a large number of people to develop small dairy herds as a commercial proposition and there are over a hundred such herds in Shillong now, all of which are supplying milk to the consumers of the town. Several of them are keeping breeding bulls of their own for their herds. These bulls are also available to the public on a small fee. The capable section of the residential public of the town are not lagging behind and many of them are keeping one or two cows to meet their domestic demand for milk, cream and butter.

Almost all the towns and cities of India are dependent on their milk supply from outside, but Shillong can be said to be self-sufficient for all practical purposes in its milk requirements, subject of course to the limitations of the purchasing capacity of the public. Besides here, as in rest of India, a high percentage of milk is used up in preparation of confectionery and sweetmeats. The local supply of milk meets this demand also. One finds more of local butter in the market than of imported tinned butter. Fresh butter in packets of different sizes, from 1 oz. to 1 lb., certainly are more convenient to the people than the tinned butter of a particular size.

This achievement, in making Shillong self-sufficient in its supply of milk and milk-products, is the result of practical demonstration at the Government Cattle Farm on one hand and facilities offered to the people to improve their economic condition through dairy industry on the other. But after all it is a localized achievement and the other parts of the province remain much the same as they

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were. Proper publicity and adequate facility to the public are the crying needs now.

Publicity of veterinary achievements

In Assam, proper publicity of veterinary work and its contribution to the economic prosperity of the people are seriously lacking, for the number of exhibitions and animal shows held in Assam are few and far between. It was by an accident that during the Civil and Military Fraternity Week held lately at Shillong, a horse and cattle show and a dog and poultry show were included in the programme. Though these were organized more on the lines of variety performances rather than those of real animal shows, the number of animals presented was quite large. By the order of the Director of Agriculture a cow and a heifer of the Government Cattle Farm were put up in the Cattle Show. These were not meant to contest in the prizes, but to demonstrate to the public the effects of proper feeding and management. It was in the fitness of things that the prizes were given to the cows and the heifers which possessed the best points of dairy value.

Last year, a deputation of the Veterinary Assistant Surgeons of Assam met the Hon'ble Ministers of Finance and Veterinary Science and they showed by figures and calculations that by means of prophylactic inoculations and vaccinations and by treatment and other methods, they were preventing a loss of over a crore of rupees to the livestock owners of the province every year. This simple truth is hardly realized by the people who are benefited, and least by those who miss no chance in demanding early improvement of the economic condition of the general mass of the country.

About a decade back, in Great Britain, a member of the Parliament, who was also a Mayor of a County, once said in a Conference of the National Veterinary Association of Great Britain & Ireland that it was very true to say that very few people realized what a great debt the country owed to the veterinary profession. It filled such an important part in the life of each and everyone that he (the Mayor) would like to see its status among other professions rise higher and higher. He added that it was essential for the well-being of the members of the veterinary profession and for that of the whole country that everyone realized the indispensability of the veterinary surgeon. The position in our country about the realization of the indispensability of the veterinary surgeon is much worse.

MYSORE

M. L. N. IYENGAR

UNDER the special food production drive instituted early this year, about 30,000 acres will be planted under *kar ragi** and 40,000 acres under *kar* paddy during the summer of 1949. *Ragi*, the staple foodgrain of Mysore is mainly grown in the *kharif* season on dry lands. In some districts it is also raised as an irrigated crop. But this practice was practically unknown in the Irwin Canal area till very recently. Owing to the failure of the monsoon in 1945, an intensive campaign was launched to introduce the cultivation of irrigated *ragi* in the Irwin Canal tract. A large number of nurseries were raised under departmental auspices and seedlings were distributed free. Seeds and manure worth about Rs. 15 per acre were issued free to *kar ragi* growers. Special bonuses were given by the procurement agencies. Liberal prizes of the value of Rs. 6,000 were awarded to the best growers. These concessions are being extended every year. During the ensuing summer, similar concessions will be granted to *kar* paddy growers also. The prize amount has been raised to Rs. 10,000. The whole

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* *Kar ragi* is generally sown in March, planted in April and harvested in mid-June releasing the land for paddy in the *kharif* season. *Kar ragi* growers are assured of adequate fertilizers for their second paddy crop.

campaign is expected to cost the Government about Rs. 5 lacs.

Lift irrigation

Rs. 1.4 lacs have been sanctioned for special lift irrigation schemes in T. Narasipur *taluk*. Pumps are proposed to be installed along the banks of the Cauvery to bring in a considerable area under food crops in summer. The subsidy that was being paid for construction of surface wells has been increased from Rs. 500 to Rs. 1,000. More than 5,000 new wells have been completed under the Scheme since 1946. Temporary agricultural sub-depots have been opened in the *kar ragi* areas at the rate of about one depot for each 500 acres. Transport of compost to paddy lands from compost centres by Departmental trucks have been arranged for.

Irrigation in the reverse

The Krishnarajasagara dam near Mysore City is designed to hold water up to a height of 120 ft. This height is generally reached in August. But during the months of March to May, the lake level falls below 80 ft. In 1946, the then Minister for Agriculture, Sri M. A. Srinivasan conceived the idea of utilizing the large water-receded areas for temporary cultivation of food crops like *jowar*. The lands were leased to cultivators in the neighbouring villages, free of assessment and *jowar* seeds were supplied free. In the present food emergency, this campaign has again been revived this year and about 3,000 acres are expected to be sown with *jowar* in the summer 1949.

Agricultural exhibitions and competitions

The first Agricultural Exhibition in the State was held during the Dasara of 1888. Since then these exhibitions, with occasional exceptions, have become a regular feature during the Dasara festivities at the capital. A couple of years before the War, one wing of the Exhibition Buildings was converted into a permanent agricultural museum open to visitors throughout the year. After nearly five years of suspension this Exhibition was revived in October, 1948. In addition to the permanent museum a spacious stall was allotted to the Department for its exhibits and demonstrations. For the first time the Department put up a stall outside the State at the All-India Khadi and Swadeshi Exhibition at Madras in December, 1948. A special collection of agricultural produce for which Mysore is famous such as coffee, cardamom, areca, copra, tobacco, *gur* and sugar was made for the purpose. Instructive charts and maps showing the main features of Mysore agriculture were exhibited.

A scheme for awarding prizes for progressive farmers has been inaugurated recently. There are three prizes for each of the nine districts and a Championship prize for the whole State. Judging committees are being formed in all the *taluks* and the awards are proposed to be made some time in January, 1950.

Mechanization of agriculture

The Department of Agriculture in Mysore has recently launched a State-wide Tractor Service. The Department owns about 135 tractors and they have been stationed, in units of 12 to 14 tractors, in each district under a Supervisor and a tractor mechanic. These machines are hired out for ploughing at Rs. 4 per acre of virgin land and Rs. 8 per acre of cultivated land against the actual cost of about Rs. 18 per acre. The lower rates for virgin land are intended to enable the cultivators to bring more fallow land under cultivation. There is a keen and growing demand for tractor service in all parts of the State and it is therefore proposed to constitute Tractor Advisory Committees to decide questions of allocation and priority so as to get the maximum benefit from the Service.

There are at present five bulldozers in the Department. Two of them were engaged in clearing about 800 acres of scrub jungle near Closepet in Bangalore District. Two model villages, Jayapura and Vijayapura, have been laid on the site and about 450 acres of land have been brought under cultivation. Date groves, acquired by the Department for locating their regional research stations under the postwar schemes, are also being cleared by bulldozers. To extend the benefits of bulldozers to cultivators the Department is forming a corps of 24 machines. Six dozers are expected to be in commission shortly.

New rural reconstruction scheme

The State Government have inaugurated a new scheme of rural development. Under the scheme, which was formally launched in all parts of the State in early March, rural development work is entrusted to *Taluk* and District Development Committees constituted for the purpose. These Committees are mainly composed of non-officials although nominated by the Government. The *Taluk* Committees have roughly one member from each *hobli* (on an averge there are four to five *hoblis* in a *taluk*) The members of the State Legislature (Lower House) residing in the *taluks* are *ex officio* members of the respective *Taluk* Committees. The *Amildar* (corresponding to *Tashildar* elsewhere) is the *ex officio* Secretary and Chief Executive Officer of the *Taluk* Committees. These Committees are to meet at least once a month and have been vested with 17 executive and four advisory functions. They are competent to sanction items of work costing up to Rs. 1,000 in each case. The grants hitherto being made to village *panchayats* and for rural water supply, inter-village communication, amelioration of depressed classes, etc. will, in future, be operated by these Committees.

The Chairmen of the *Taluk* Committees in each District and five other members will form the District Development Committee. The District Committees are largely supervisory and coordinating bodies exercising control over *Taluk* Committees. They can sanction works costing between Rs. 1,000 and Rs. 5,000 under each item. The District Development Officer is the *ex officio* Secretary and the Deputy Commissioner of the District, the Chief Coordinating Authority.

At the centre, there is a Central Development Committee presided over by the Minister for Rural Development and composed of the Chairmen of District Committees, heads of all Development Departments, five Depressed Class Representatives and five other nominees. The Rural Development Department is now a full-fledged Department and its Commissioner is the *ex officio* Secretary of the Central Committee. A small Committee consisting heads of Development Departments coordinates the work on the official side. Similar coordinating bodies are proposed for districts and *taluks*.

The *Gramasudarakas* of the old scheme are replaced by Revenue Inspectors, whose jurisdiction is reduced to about 25 to 30 villages. A separate budget head and a special Rural Reconstruction Fund have been constituted.

On the material side, emphasis has naturally been laid on Agriculture and Cottage Industries. But the improvement of the morale of the people and of the spiritual side of the ryots' lives are as important if not more, and it is in the emphasis on the latter that the new scheme mainly differs from the old.

The nine popular Ministers inaugurated the scheme in the nine Districts on 6 March, 1949. The Maharaja of Mysore in a special message on the occasion expressed his hope that the village may once more become a unit as much of culture as of prosperity and happiness.

Multipurpose cooperative societies

A scheme for the organization of multipurpose cooperative societies in all the District and *Taluk* Headquarters has been prepared by the Registrar of Cooperative Societies. The main object of the scheme is to consolidate and widen the scope of the cooperative movement and bring, in a short period, almost all the villages within its fold. It is proposed to organize a society in every village having a population of 500 or more. In the initial stages, these multipurpose societies will be granted liberal subsidies and facilities for erecting godowns.

TWO METHODS OF DEHORNING CALVES

By R. HENSON

THE growing practice of yarding cattle, especially dairy animals, is directing attention more and more to the advantages of dehorned stock. More such cattle can be kept in each yard, they can be handled with less risk of personal injury, and the food is shared more economically. With fattening stock there is no risk of the scars and bruises so often seen in the carcasses of horned animals. Bullying is not unknown amongst hornless cattle, but usually with the loss of their horns, horned breeds lose their fighting instinct. They can be driven through gateways without fear of that glancing blow which will rip a cow's udder and leave the way open for mastitis.

It is argued against dehorning that it is unnatural and that it spoils the appearance of our animals. Many farm practices now accepted as routine are also unnatural: lambs are docked, and male animals not wanted for breeding are castrated for good and sufficient reasons. The presence or absence of horns should not be allowed to distract attention from the points that really matter—milk or beef—neither of which has anything to do with an animal's horns. One may become accustomed to the appearance of hornless stock. Angus and Red Poll fanciers would not think their cattle improved if horns were grafted on. It is not their horns that give the Ayrshires a high place in the dairy world; it is their udders and their ability to produce milk. American and Canadian practice is more and more tending towards dehorning all cows.

The dehorning of older cattle requires the services of a veterinary surgeon; because of the pain involved it is done under an anaesthetic. Inevitably the animal suffers from shock, with at least some temporary loss in production, and there is always the danger of bacterial infection of the frontal sinus. The best time to dehorn, therefore, is before the horns have begun to grow, that is, in the first week or two of the calf's life. For some time it has been felt that the old methods of dehorning are not as satisfactory as they might be. Caustic soda or potash sticks have many disadvantages. They need very careful handling and it is easy to use too much and so cause excessive burning—even damage to the calf's eyes by drainage from the treated site.

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Guthrie[1] (1947), after preliminary tests with various dehorning agents, found that a flexible collodion solution of antimony trichloride gave the most satisfactory results. He claimed that this material was easy to apply and that the solution dried quickly into a firmly adhering flexible film which destroyed the underlying tissue with much less pain than the alkaline dehorning agent. He also maintained that there was no 'weeping' of fluid to endanger the eyes. The formula recommended by him was:

	Per cent
Antimony trichloride	28
Salicylic acid	7
Flexible collodion	65

Another method of dehorning calves is by cautery. Rowe[2] (1947) was reported to have adapted an electrical soldering iron to form an efficient cauterizer, and this had obvious advantages over a fire-heated iron. The solid metal end of the iron was hollowed out to form a ring 1/8 in. thick, 5/16 in. deep, and with an internal diameter of ½ inch. The iron, heated by electricity, was held over the developing horn bud to sear a complete ring of tissue around it and thus prevent growth.

A test of these two methods has been made. The primary objects were to discover:

(i) The amount of irritation,

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[1] Guthrie, J. E., *Vet. Med.* (1947) **42,** 8.

[2] Rowe, J. E. *Farmer and Stock Breeder* (1947) Oct. 14, p. 2319.

(ii) The relative efficiency of the two methods.

(iii) The most suitable age for the operation.

By chemical agent

Twelve Dairy Shorthorn, Ayrshire and cross-bred calves of ages varying from 2 days to 5 weeks were treated. The hair was first clipped away from the horn bud and the area cleansed by a swab dipped in spirit. The preparation was then applied, care being taken not to touch the surrounding skin. The area covered was roughly the size of sixpence. As the solution will corrode metal, a wooden-handled brush, such as is used for glue, was found to be the best method of application. The solution dried very quickly to form a skin over the area.

One calf, No. 7 (see Table I), was clipped but not cleansed before applying the agent. This calf showed signs of irritation and a tendency to rub the affected area against the rails of the pen. There was slight growth of one horn. The younger the calves when treated the less was the irritation. With the exception of No. 7 those dehorned at ages up to 10 days showed little sign of discomfort. Older calves showed signs of pain, especially Nos. 1 and 2. These calves had well-established horn growth, and much more of the solution had to be used on them than on the younger calves. There was no pain whatsoever at the time of application.

TABLE I

Calves treated with chemical agent

Calf No.	Breed	Age when treated	Age when last observed	Visible horn growth		Remarks
		Days	Weeks	Right	Left	
12	Ayrshire ..	2	12	None	None	
6	Shorthorn ..	4	16	,,	,,	
7	Ayrshire ..	6	15	Slight	Slight	Horn buds not cleansed
9	Shorthorn ..	7	14	None	None	
5	,,	8	12	,,	,,	
8	,,	9	14	,,	,,	
4	Ayrshire ..	10	18	Slight	,,	
11	Shorthorn ..	11	18	None	Slight	
10	,,	13	18	Strong	None	
3	Ayrshire ..	18	11	,,	Strong	
1	Cross-bred ..	28	20	,,	,,	
2	,,	35	20	,,	,,	

Table I shows the results of the treatment of the twelve calves. With those noted as showing strong horn growth, there is no sign of checking at all. Those marked 'slight growth' have a thickening or swelling at the site of the horn which, however, has shown very little growth in three months. Those indicated as having no growth show no signs of horns; the hair has grown over the area and to all appearance they might have been born naturally polled.

Age

The amount of horn growth at a particular age varies with the breed and with individual animals. Some calves will have no more horn growth at 14 days than others at 2 days. Nevertheless, the best time of treatment to obtain consistent results would seem to be within the first week, preferably the day after calving. The horn bud can then just be seen and can be destroyed with a minimum of solution. The older the calf the more likely it is to rub, as there is more tissue to burn and, therefore, more irritation; moreover, an older calf is more sensitive.

By electrical cauterizer

The iron was connected by a three-point 5-amp. plug, since it is important to earth these irons to avoid any risk of shock to either the operator or calf. It was not found possible to overheat the iron; indeed at the 'peak periods' of the day it was difficult to heat the iron sufficiently. The operation is easier if the hair is clipped away from the horn bud first; but this is not essential. Pre-clipping also saves the iron from becoming covered with half-burned hair, as it would be where several calves have to be done.

The iron was held to each horn bud momentarily and then the operation repeated. In practice it was found to be impossible to burn the calves too much; their struggles inevitably dislodged the iron as soon as its work was done. When the operation was finished there was a complete ring of seared tissue around the horn bud. The operation is, of course, momentarily painful but the calf appears to feel no distress afterwards.

Table II gives the results of the six calves treated. The four younger calves on which the treatment was successful look as if they are naturally polled. Calf No. 15, noted as having 'some growth' has thickened, blunted horns, far shorter than normal. Calf No. 16 is developing normal horns.

TABLE II

Calves treated with the electrical cauterizer

Calf No.	Breed	Age when treated	Age when last observed	Visible horn growth		Remarks
		Days	Weeks	Right	Left	
18	Cross-bred	4	14	None	None	
17	Ayrshire	7	12	,,	,,	
13	Cross-bred	18	15	,,	,,	
14	,,	21	20	,,	,,	
15	,,	28	26	Some	Some	
16	,,	35	26	Strong	Strong	

Here again, the earlier the operation the less tissue there is to sear away and therefore less pain to the calf. Also, the younger the calf the easier it is to hold. One calf was successfully treated at 4 days, but a week to 3 weeks seems to be the optimum age; that is as soon as there is sufficient growth to hold the iron in position.

Discussion

Both methods proved satisfactory, provided they were carried out within certain prescribed age limits: 1 to 9 days for the chemical dehorner and 4 to 21 days for the cauterizer. The chemical dehorning agent has two outstanding advantages over the electrical cauterizers: (1) The operation can be performed anywhere the calf may happen to be lodged, whereas the other method requires a supply of electricity, the presence of a convenient power point, and haltering and leading the animal to that point. There is also the time taken for the iron to heat, which is anything from 15 to 30 minutes. (2) Although there are three operations involved in using the solution, all are simple and practically painless, and they can be done by one man if necessary. With the cauterizer, although it is not necessary to prepare the site first, two men are required, and sometimes even then the calf is difficult to hold.

The chemical method has one disadvantage. If any of the solution is accidentally placed on the surrounding skin the irritation may cause the calf to run the area and thus impair its action, but this may be obviated by carefully wiping off any such solution immediately.—Reproduced from *Agriculture*, January, 1949.

PRESERVATIVE FOR *NEERA*

As a result of experiments in the Indian Institute of Sugar Technology, Kanpur, a preservative for *neera* (sweet palm-juice) has been found. By application of this preservative, *neera* does not undergo any fermentation for a number of days and can safely be used as a non-alcoholic drink. It can be transported over long distances without any effect on the quality.

The amount of preservative required to be added is very small and does not cost more than one pice per maund of *neera*. *Gur* can be manufactured from *neera* thus preserved, without any loss of sugar. The preservative has no colour or taste and is harmless.—*P.I.B.*

Home Gleanings

USE OF POTATO CHIPS, EYES, AND SPROUTS AS SEED

By M. J. DESHMUKH

ALTHOUGH it was common knowledge that propagation of potatoes from small pieces of a whole tuber was possible under suitable conditions, its practical utilization was first taken up in the U.S.S.R. during the World War II. War conditions made it necessary to increase the area under potatoes in the U.S.S.R. because they furnish more food and industrial raw material per acre than any other crop. The supplies of seed, however, were insufficient to allow much expansion. The shortage was overcome by using potato tops (a small piece with an eye cut from the rose end of the tuber, the piece being nearly 1/10th in size of the whole tuber) as seed and using the remaining portion (nearly 90 per cent) for food or processing purposes. The method was elaborated by Prof. Lysenko and his co-workers at the Lenin All-Union Agricultural Academy[1]. In 1942 a total of nearly 3,80,000 acres were reported to have been planted with tops in various parts of the South-east and Centre of the U.S.S.R. and the yields from the tops were not inferior to those of potatoes planted in the usual way, and in regions where ring rot is prevalent plants grown from tops were reported to be less liable to the disease than those from the seed. The idea was carried still further by Prof. Yakushkin of the Timiryazev Agricultural Academy, Moscow, who planted an eye itself with a small piece of flesh attached and obtained encouraging results[2].

Subsequently this line of work was undertaken elsewhere with a view to evaluating the suitability of this new method. Evans[3] (1943) in England found that whereas tops (1 in. in diameter, 1/14 in. in thickness at the thickest part, planted 12 in. apart in rows 2 ft. 6 in. apart and at a depth of 2 in. to 3 in. in the soil) yielded 526 lb. of tubers from 1/60th of an acre, the whole tubers yielded 613½ lb. under similar conditions. He calculated that only 3 cwt. (nearly 4 maunds) of tops would be required to plant 1 acre against 13 cwt. (7·18 maund) of whole tubers. Copisarow[4] (1943) reported that 288 tops (each of ½ in. diameter, ¼ oz. in weight, planted in boxes) from 24 lb. of potatoes gave 804 tubers weighing 172 lb., each plant yielding nearly 10 oz. Pal and Deshmukh[5] (1944) conducted experiments in India. They found that whereas 100 plants raised from whole tuber of Phulwa (each tuber approximately weighing 21·45 gm.) yielded 51·5 lb., 100 plants raised from tops (each weighing 4·2 gm.) yielded 33·4 lb., 100 plants raised from 'eyes', on the other hand, yielded only 18·7 lb. As a result of these preliminary observations it was thought possible to improve the yields from tops under suitabtle spacing and manuring. Accordingly an experiment initiated (Pal and Deshmukh, unpublished work) in 1944-45 with 3 spacing (1½ ft.×6 in., 1 ft.×6 in.) and 3 manurial treatments (no manure, a manurial mixture before planting and the same after planting) was conducted for three years. The results indicated that tops of Phulwa yielded slightly less than whole tubers under all treatments. Sen and Chakravarti[6] (1945) confirmed the earlier results of Pal and Deshmukh (loc. cit.).

Polunin[7] (1943) drew attention to the use

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[1] Anon., Soviet scientific work on potatoes, *Nature*, **150**, 456-457, 1942.

[2] Garner, H. V., Intensified potato culture in the USSR, *N. Min. Agric.* **50**, 20-21,1943.

[3] Evans, G., Potato eyes as readily transportable seed for the colonies, *Nature*, **152**, 464-466, 1943.

[4] Copisarow, M., Potatoes and war economy, *Nature*, **151**, 421-422, 1943.

[5] Pal, B. P. and Deshmukh, M. J., Potato tops and eyes as seed, *Curr. Sci.*, **13**, 309-311, 1944.

[6] Sen, B. and Chakravarti, S., Potato seeds from chips, *Curr. Sci.* **14**, 44-46, 1945.

[7] Polunin, N., Economical Potato propagation with remarks on detached sprouts, *Gardeners' Chronicle*, **113**, 36-37, 1934.

of detached sprouts as seed. He took sprouts 4½ in. in length and planted them in boxes. He obtained nearly 6·5 lb. from eight plants raised from sprouts.

Pushkarnath[8] (1945) conducted detailed experiments on potato sprouts as a source of seed. According to him the sprouts, when they are about 1 in. to 2 in. in length, are detached from the tuber and planted in a nursery 3 to 4 weeks earlier than the normal time of planting and transplanted in the field when the sproutlings are 4 in. to 6 in. in height. At Simla the yields obtained from them were reported to be as good as those from whole tubers. The use of sprouts as seed is already proving very helpful in rapidly building up the stocks of new potato varieties or hybrids at the Potato and Wheat Breeding Substation, Simla.

Two important questions emerge out of the above observations. Firstly, do the plants raised from smaller sets, i.e. tops (chips), eyes, sprouts, etc. yield as well as those raised from the whole tubers? If this is possible then, the second problem refers to the commercial utilization of this method, including method of storage, transport and cultivation. If the smaller sets can be profitably used as seed on a commercial scale, there would be considerable saving in seed and consequently an increase in food. Also if suitable methods of their storage and transport are developed, there would be a great economy in storage and transport expenses.

Experiments so far done in India have indicated that the chips (tops) and eyes do not yield as well as the whole tubers. Although Pushkarnath found the yield from sprouts as good as from whole tubers, experiments done at the Division of Botany, Indian Agricultural Research Institute, New Delhi, and at Kanpur (Mitra, 1947, personal communication) have not given such good results. It must, however, be borne in mind that Pushkarnath conducted his experiments under the conditions of the hills which are quite different from those prevalent in the plains for potato cultivation. In this connection Bushnell (1930) observed that there was a gradual decrease in the yield of potatoes as the chips (used as seed) decreased in weight from 15 gm. below. In his opinion if the chips have to give favourable yields, each of them must weigh at least ½ oz. and should be 7/8th of an inch in thickness in the centre. In the experiments so far conducted in India, chips of much smaller weight have been used as seed. Purewal[9] (1947) also obtained similar results with potato peelings and chips. He stated that the loss in yield from smaller sets was much more than the saving effected in the quantity of seed planted. Work on smaller sets is also being conducted at the Bose Research Institute, Calcutta, but no published record of the work was available to the writer.*

Therefore, it has yet to be established whether the chips, eyes and sprouts can yield as well as the whole tuber under Indian condition. However, these smaller sets can be profitably used for the rapid multiplication of new varieties the material of which is very limited at the beginning.

Much work has been done on the methods of storage and transport of such smaller sets. Scannell[10] (1937) has referred to the certified seed 'potato eye' trade in Canada. He states that this trade started about 25 years ago in the Prairie Provinces. He further states, 'Conditions were quite different then to what they are now. Settlers were moving into all parts of Western Canada and many of them were a good many miles from railways. By cutting potato eyes and mailing them good seed was made available to settlers in all parts of the country'. According to Scannell the eyes are cut from the tubers by three methods:

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[8] Pushkarnath, Potato sprouts as a source of seed, *Curr. Sci.* **14,** 236-237, 1945.

* Investigations were conducted at the Bose Research Institute by Dr B. K. Kar with a view to find out (1) a method for preserving the cut chips of varying sizes 1 cm. to 2·5 cm. over a longer period and prevent them from desiccation; (2) to find the growth and yielding capacity of the chips—severed from the mother tuber at different periods of their preserved life from the harvesting time to the sowing time; (3) to find out if the severed sprouts from mother tuber can be practically utilized for propagation.

Attempts were made to prevent excessive desiccation by suberizing the cut surfaces or by covering the cut surfaces with a special mixture of shellac-wax—India rubber and then storing them in a refrigerator. Sealed chips showed less desiccation and sowing experiments also showed better germination and yield dependent, however, upon (1) time of severance from the mother tuber; and (2) period of preservation. Germination percentage, growth and ultimate yield increased, with shorter the period of life of the chips separated from the mother tuber with consequent loss of desiccation and period of preservation. But the yield from the chips was found to be less than the normal sowing. The severed sprouts were not found practical for propagation. (loc. cit.—Ed: Sci. & Cul: and also refer—Isolated potato eyes as seeds for propagation by B. K. Kar, *Ind. Jour. Hort. Soc.* **II,** 41, 1944.)

[9] Purewal, S., Potato buds as seed, *Punjab Fruit J.*, **11,** 253-255, 1947.

[10] Scannell, J. W., Development of the certified seed 'potato-eye' trade, *Amer. potato J.*, **14,** 23-25, 1937.

(i) An instrument resembling an apple corer: the corer is placed over the eye and pushed through the tuber making a cylindrically shaped set with an eye at least at one end. The borer is an inch in diameter and the length of the set is governed by the size of the tuber: 10 sets weighed 6½ oz.; (ii) A potato parer bent into a semi-circle: this method produces sets of a conical shape and of small size: 10 sets weighed 2 oz.; (iii) A vegetable baller: it is a kitchen utensil. The eyes are cut in semicircular form, approximately an inch in diameter and an inch across at the deepest point: 10 sets weighed 4 oz. The sets are thoroughly coated with slaked lime to prevent drying out and shrinking and can then be kept for several weeks without any apparent deterioration. Later, they are boxed or rolled in oiled paper for transport. It is estimated that in the spring of 1936 nearly half a million eyes were sold in Western Canada. According to the third method of cutting one bushel (60 lb.) of Irish Cobbler variety gave about 1,000 eyes. After the saleable eyes have been removed the remainder of the tuber is used for planting. Scannell further reports that very satisfactory yields were obtained by using seed potato-eyes.

Evans (loc. cit.) undertook experiments to develop a method of despatching potato chips by air with reasonable assurance that when planted they would be capable of giving a fair crop. Allowing for reasonable delays in packing, despatch and distribution, it was considered that the chips would have to retain viability for about a month. According to him the tuber is held in the left hand and a thin chip (1 in. diameter, ¼ in. thickness in the centre) cut off the rose end with a sharp knife. The chips were collected and placed with cut surface upward on shallow trays, the bottoms of which were covered with a thin layer of peat-moss litter. The trays were placed in shelves in a wooden seed store-room at ordinary temperature. The chips 15 days old gave 80 per cent germination and had shrivelled to nearly half the original size. He calculated that 112 lb. of such dry chips would be necessary for planting one acre.

Marritt[11] (1944) described treating, packing and storing potato eye-sets. According to him, eye-sets are becoming an increasingly important factor in the seed potato trade in Canada because they can be widely distributed at little cost. The eyes are scooped out (½ oz. in weight, 7/8 in. in thickness in the middle) with a vegetable baller; they are then washed out in clean water; soon after that they are packed in moisture proof paper. A wax-coated carton wrapped with waxed craft paper is considered a standard package containing 25 eyes. The eye-sets are then stored at about 77°F., for 4 days to a week and then at 38°F. until shipped. After they reach the destination they are again stored at 35°F. till planting.

Nattrass[12] (1945) has summarized the position regarding the healing of the potato pieces. If cut surface is exposed to dry air, it forms a hard crust which readily cracks. There is a considerable shrinkage and loss of moisture. If on the other hand the cut surface is kept in a moist atmosphere, 12–36 hours after the walls of the cells immediately below the cut surface become covered with a deposit of suberin which form a continuous layer blocking the cut surface. This not only prevents loss of moisture but effectively bars the way to rotting organisms such as bacteria and moulds. Within a further period, the duration of which depends on the variety and the temperature, the cells immediately below the blocked surface divide to form a layer of suberized cells which eventually develops into a skin similar in structure and function to the outer skin of the tuber.

The natural healing process can be induced by keeping the cut pieces in a moist atmosphere for 2–4 days after cutting. This can be done by placing the cut pieces in a shallow layer and keeping them covered with moist sacks. The properly healed sets can withstand exposure almost as well as mature whole tubers. Nattrass found that nine months after cutting, the cut pieces were in excellent condition. By this method there is not much loss in weight. Four chips weighing 40 gm. underwent only 23 per cent loss in weight after healing while by Evan's method the reduction in weight is nearly 50 to 60 per cent. But by this new method the chips can be stored for a long period.

[11] Marritt, J. W., Treating, packaging and storing potato eye-sets, *Sci., Agric.* **24**, 526-532, 1944.

[12] Nattrass, R. M., The cutting and treatment of seed potatoes, *East African J.*, **11**, 83-85, 1945.

These pieces have been successfully sent by air from Kenya to England.

At Simla detached sprouts have been found to retain their viability for a week when placed in moisture-proof packets.

The position regarding the use of smaller sets of potato, i.e. chips (tops), eyes and sprouts for seed may be briefly summarized. Experiments so far conducted in India have indicated that the smaller sets generally yield less than whole tubers. One of the reasons for such low yields of the smaller sets may probably be that the sets used by the workers in India have been invariably less than ½ oz. in weight; according to Bushnell (loc. cit.) such small sets give correspondingly low yields. This then means that more elaborate experiments are necessary to evaluate the potentiality of the smaller sets. It is quite possible that sets of suitable size, if planted with proper spacing and manures, may give yields which may favourably compare with those from whole tubers. Although the work at Simla has shown that the sprouts can be profitably used for rapid multiplication of improved varieties, more extensive work, particularly in the plains, is necessary to evaluate the possibility of its commercial utilization.

Although sufficient work seems to have been done abroad on the problems of storage and transport of smaller sets, it will be necessary to work out these problems for the conditions prevalent in India both in the plains and the hills. Also it will have to be seen how far the disadvantages of low yields of smaller sets and items of additional cultivation like preparing and raising a nursery and transplanting, particularly in the case of sprouts, will balance the advantages of small quantity of seed (which means saving in food, low costs of seed and storage) and low transport expenses.

If, therefore, smaller sets of potato, particularly the chips of suitable size give fair yields, and if suitable methods of their storage and transport for local conditions are worked out, it will help to a great extent towards the expansion of potato acreage in India. And more potatoes means partial fulfilment of an urgent need of the nation, more calories per capita per day.—Reproduced from *Sicence and Culture*, May, 1949.

HALF TON OF POTATOES FROM TWO POUNDS OF SEED

WHAT is believed to be a record potato yield for Australia was established in the 1949 season by Mr. C. B. Powell of Clarendon, South Australia. From 2 lb. of seed potatoes, he grew 1,336¼ lb. of tubers, a ratio of 668⅜ to 1.

The variety planted was the recently introduced American Sebago, which has become very popular in the hill districts of South Australia during the last two seasons.

Seed was cut into 163 sets, of which 152 grew to maturity. Digging and weighing of the crop was supervised by members of the Agricultural Bureau.

Tubers from 14 plants in an average row filled a sack weighing 148 lb., an average of approximately 10½ lb. a plant, but one individual plant produced 18 lb. of potatoes, some of which weighed 3 lb.—*Australian Agricultural Newsletter*, No. AGN/249.

Book Reviews

SOIL EROSION—ITS PREVENTION AND CONTROL

(Published by the Government of Madras, 1948.)

THE rapid depletion of the soil resources of India by erosion and the subsequent effects in lowering the general standard of living of the masses has only recently been realized by the governments in India. Any book, at this juncture, which would create real interest in the country on soil erosion and its control is, indeed, welcome. The Madras Government is to be congratulated for having taken a bold step in bringing out a text-book on soil erosion for the use of Departmental Officers and for teaching the subject in the Agricultural and Forest Colleges.

The subject matter of the book is divided into eighteen chapters and is profusely illustrated. Lessons of the past as well as of modern times of soil erosion have been presented in Chapter I. Examples of damage caused by erosion in different parts of the world have been cited. The chapter begins with a definition of soil which is hardly apt. A definition of soil could have been more precise as the one given by Joffe—'The Soil is a natural body, differentiated into horizons, of mineral and organic constituents, usually unconsolidated, of variable depth, which differs from the parent material below in morphology, physical properties and constituents, chemical properties and composition and biological characteristics'. In addition to the description of the destructive processes leading to the accumulation of soil materials, the constructive aspect of soil formation leading to the development of soil profiles should have found a place.

Chapter II deals with the agencies and the types of erosion that are generally met with. The results of erosion in silting up of reservoirs and irrigation canals, reduction in underground water supply, etc. are also broadly dealt with. The chief causes of accelerated erosion are given in Chapter III. Nine causes are enumerated but only four of them have been explained in some detail. Under 'soil variable qualities', only the texture and the structure of soils have been dealt with. But other soil characteristics such as soil depth, permeability, nature of colloids, etc. which are significantly correlated with the erodibility of soils, are not touched upon. An elucidation of these factors would certainly add to the value of the book.

Chapter V is well-written and contains much useful information. The question whether 'waste weirs', even in contour bunds, are necessary or not, is still a moot point. The intensities of rainfall as also the peculiar characteristics of the Black soils of Karnatak do call for, if not waste weirs, some other mode of excess-water disposal. In Chapter VII, the items of dry farming and terracing have been discussed. Soil and moisture conservation problems are interdependent and a great deal of work has been done in India. Hence the subject of dry farming might have usefully been discussed in greater detail in this chapter. The subject of terracing could have been dealt with in more detail and also discussed in Chapter V along with contour bunding. Such important questions as the 'uniform grade' and 'variable grade' terraces, their length and cross sections should find a place in a text-book.

Chapter X dealing with the agronomic or the biological aspect of erosion control has been treated cursorily. The effects of various types of mulches and the place of legumes and grasses in erosion control practices are not fully emphasized. The method of laying out contour strip cropping on the land, selection of suitable cover crops, their seed rate, width which could be adopted with advantage in different soil types, slope, climatic complexes and their ultimate effect in soil development and increased crop production need to be dealt with in a text-book of this kind. In the suggested land-use recommendations in this chapter, only slope and degree of erosion have been taken into consideration. A major factor such as soil type, which is vital for any land-use planning has been left out.

In Chapter XII, XIII and XV the questions of types of dams and the control of stream and river bank erosion have been compiled very satisfactorily. The last chapter dealing with erosion and malaria although of vital importance to India occupies, for a text-book on soil conservation, too much space. Lastly in this volume, one vital omission is a chapter wholly dealing with *soil conservation survey* of all cultivable areas including suggestions for land classification and land-use planning. No text-book could be considered complete without it. Otherwise, the volume is on the whole, timely, well written, definitely informative and useful. The subsequent volumes to follow on the subject may well be expected to be more comprehensive. The minor printing errors, not a few, are common with all our printers. (J.K.B.)

⁂

COMMERCIAL FRUIT AND VEGETABLE PRODUCTS

By W. V. CRUESS (Published by McGraw, Hill Book Company, New York, 3rd Edition, 1948, pp. 906, $ 8·5)

THIS internationally distinguished author and his well-read book need no special introduction to the readers. His book has served for over twenty-four years all students of food technology and horticulture and in this third edition the author has put in lots of new material and data as well as many new illustrations. These represent developments in the various phases of the science of food technology during the past many years especially in canning, freezing and dehydration. A singular addition to this new edition is the chapter on 'Plant Sanitation' which deals with a very essential and important aspect of food processing, particularly in the recent years. All the materials have been presented up to date.

The book has covered all the principles and commercial applications of canning, freezing and dehydration of fruits and vegetables, beverage making, manufacture of jams, jellies, marmalades, fruit and vegetable concentrates, pickle making, wine and vinegar making, etc. Some chapters cover the various aspects of spoilage and their control, utilization of waste fruits and vegetables and disposal of wastes. An interesting chapter on packing cases and other methods of packing has also been briefly presented. At the end of each chapter a useful reference list of books, bulletins and original articles on the various subjects has been given, which will be of considerable help to those who want to go into details.

The subject of fruit technology has shown great progress and possibilities and it is rather difficult to write a single and comprehensive book covering canning, freezing, dehydration, etc. since each one of the branches might well be dealt with in a separate volume. In this edition credit goes to the author for presenting the whole field in a instructive and informative manner, giving most of the up-to-date details on the various branches of fruit technology without sacrificing any of the fundamental principles and fresh advances.

The book is recommended to all those engaged in the fruit industry as well as to all the students and teachers of fruit technology. It is the only outstanding 'all-in-one' compilation so far available dealing with all the processes involved in the manufacture of fruit products and in fruit preservation. The fruit world must be greatly indebted to the author for putting his life-time study and energy in this new edition for its benefit. (G.S.C.)

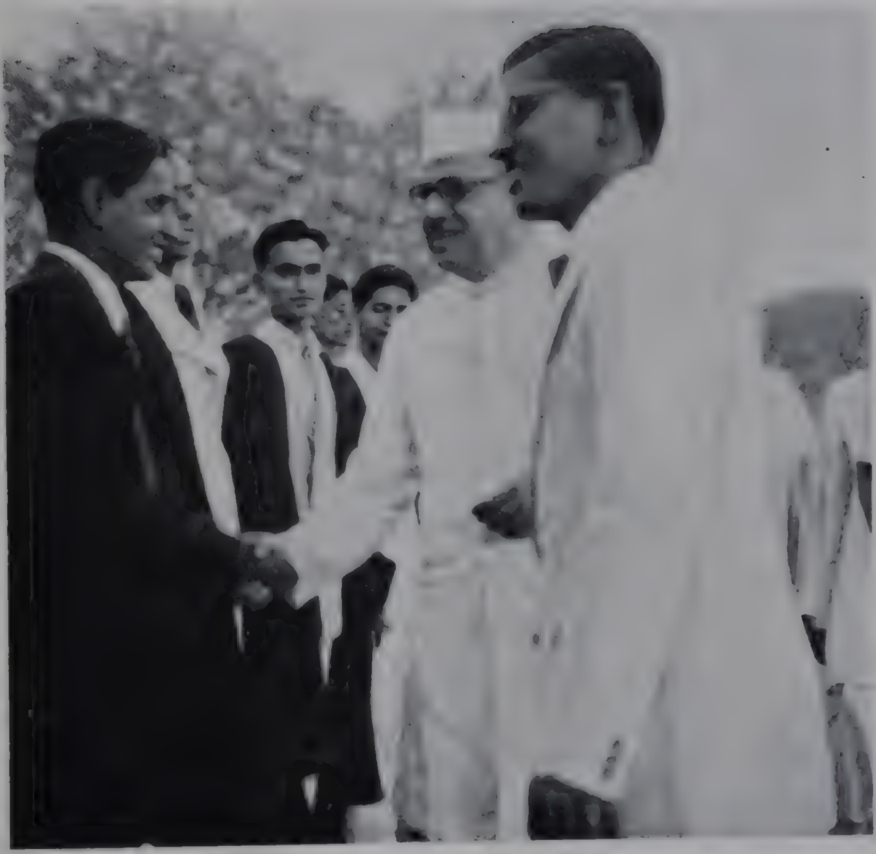

FIG. 1. The Hon'ble Shri Jairamdas Daulatram meeting the teaching staff. Photo G. C. Sharma.

PLATE 46

CHICAGO
CHICAGO

The Hon'ble Shri Jairamdas Daulatram addressing the Second Annual Convocation for the award of diplomas to the students of the Statistical Training Courses of the Indian Council of Agricultural Research.

News and Views

I. C. A. R. CONVOCATION

THE Second Annual Convocation for the award of certificates and medals to the students of the Statistical Training Courses of the Indian Council of Agricultural Research was held at the Constitution Club Hall, New Delhi, on the evening of 4 May, 1949, before a distinguished gathering. The Convocation was presided over by the Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture. All the students and the teaching staff appeared in academic gowns. Sardar Datar Singh, Vice-Chairman of the Council, was unavoidably absent but the speech which he prepared for the occasion was read out by Shri S. M. Srivastava, Secretary of the Council. In his welcome address Sardar Datar Singh explained that the Training Courses provided training for two groups of students. The first group consisted of research workers in agricultural and animal husbandry sciences whose primary interest was not statistics but for whom statistical methods were important tools of research. The second group comprised of those who had statistics as their primary interest, and who were to earn their living as professional statisticians in agricultural and animal husbandry institutes and Departments of Agriculture in the provinces and at the Centre. The first group of students, who were usually officers deputed by the provincial and State Governments for statistical training, had a shorter course extending over a period of nine months split into two terms of four and half months each. For the second group of students, two courses of training were prescribed, namely, the Certificate and the Diploma Courses. A student of the Certificate Course was expected to acquire mastery over the fundamentals of statistical science and its application to agriculture. Students successfully completing the Certificate Course as also a few others with high academic qualifications in Statistics were allowed to go in for the Diploma Course which required acquaintance with methods of advanced and regional research. The requirements of this course corresponded to that of a Doctorate Degree of an Indian University. Sardar Datar Singh announced that the Food and Agriculture Organization of the United Nations were proposing to set up an International Training Centre under the Indian Council of Agricultural Research for training of delegates from Asian countries in census methods in connection with the forthcoming F.A.O. agricultural census.

After this welcome speech, Dr Sukhatme, under whose direction the Training Courses are organized, read out his annual report describing the activities of his section during the past year. In his report he referred to the difficulty of advanced students having to leave off their studies due to financial or other considerations. This, he said, was a loss to the cause of statistical research as a whole and he pleaded that certain research scholarships on the lines of those available in the Universities for advanced research should be available to the successful and promising students in these Training Courses so that they could be employed as research scholars for carrying on original and advanced research in statistics.

After the report was read, the Honourable Shri Jairamdas Daulatram gave away the Certificates. The names of the following successful students are mentioned below:

Short Course

1. Mr. G. D. Chakrabarty.
2. Mr. P. R. Yeri
3. Mr. R. Devarajan
4. Mr. A. C. Mathur
5. Mr. A. G. Kavitkar
6. Mr. J. C. Victor
7. Mr. K. N. Vali
8. Mr. Gurdial Singh
9. Mr. Vidya Sagar
10. Mr. M. L. Shukla
11. Mr. K. S. Sinha

12. Mr. M. Gangarudriah
13. Mr. J. S. Srivastava
14. Mr. C. C. Das
15. Mr. A. Sitarama Rao
16. Mr. B. P. Patel
17. Mr. R. N. Chaturvedi
18. Mr. P. K. Chakrabarty

Certificate Course

1. Mr. B. V. Sukhatme
2. Mr. Faqir Chand
3. Mr. K. V. R. Sastry
4. Mr. R. S. Asthana
5. Mr. C. V. Rao
6. Mr. Daroga Singh

Diploma Course

1. Mr. P. N. Saxena

Shri B. V. Sukhatme and Shri P. N. Saxena were awarded a gold medal each for standing first in the Certificate and Diploma Courses respectively.

The Hon'ble Shri Jairamdas Daulatram then delivered his convocation address*. (D.J.S.G.)

---

*The address is printed as the leading article in this issue.

TESTING COTTON TEXTILES AND CORDAGES FOR RESISTANCE IN ATTACK BY MICRO-ORGANISMS

TEXTILE materials are liable to deterioration by the action of micro-organisms like bacteria and fungi, in transit, in storage or in use. Such deterioration is facilitated by the climatic conditions prevalent in tropical countries like India. The need for protection of textiles from the attack of micro-organisms and procedures for the evaluation of resistance conferred by suitable treatments are clearly essential.

The Textile Division Council of the Indian Standards Institution has, therefore, brought out the Draft Indian Standard Procedures for Testing Cotton Textiles and Cordages for Resistance to Attack by Micro-organisms. It has been prepared by the Textile Chemistry Sectional Committee, composed of technologists and producers in the textile industry in India under the Chairmanship of Dr T. S. Subramanian, Superintendent, Technical Development Establishment Laboratory (Stores), Kanpur.

The procedures described in this standard are applicable to cotton textile materials like plain and water-proofed fabrics, webbing, yarns and cordages and serve to assess the resistance of these materials to attack by micro-organisms. The methods also hold good for textiles which have received treatments aimed at increasing their resistance to micro-organisms. These methods of test can, therefore, be applied for the evaluation of compounds and treatment processes designed to protect textile fabrics and cordages from damage by micro-organisms.

Three principal methods of test have been described in this specification, viz. the Accelerated Mildew Infection Method, Aspergillus Niger Method, and Soil Burial Method. There are seven appendices detailing experimental procedures to be adopted for the tests laid down in the standard.

In accordance with the procedure of the Indian Standards Institution, every draft specification or code prepared by a Sectional Committee or Sub-Committee, after its approval by the Sectional Committee, is to be issued in proof form for a period to be determined by the Committee but not less than three months and widely circulated amongst those likely to be interested, for the purpose of securing critical review and suggestions for improvement. Comments received from all quarters shall be given due consideration by the Sectional Committee; and the revised final draft will then be put up to the Textile Division Council for endorsement. Before being finally accepted as an Indian Standard it must be approved by the Executive Committee and the General Council of the Institution.

The draft has accordingly been widely circulated to industrialists and technologists in the field. Comments will be received up to 30 June, 1949 by the Director, Indian Standards Institution, Block 11, Old Secretariat, Delhi 2.

DRAFT INDIAN STANDARD ON WOOL FOR EXPORT

BY far the most urgent and important problem that confronts the Indian wool-exporting industry today is the variability and, more or less, uncontrolled quality of the wool that is being sent out of the country. The adverse effect of such a procedure on the reputation and on the economic returns to the industry is fairly evident.

An effective remedy that would help the industry to grow on sound lines is to standardize the various grades of exportable wool and to ensure that the exported product conforms to those standards. The importer abroad, being thus assured of uniform quality of wool in the respective grades, can confidently trade with the country, and will perhaps be ready to pay a premium for such assurance.

With these objects in view the Textile Division Council of the Indian Standards Institution has drawn up a draft Indian Standard Specification for Grading of Wool for Export. This standard applies to wool produced in India, and specifies grades both according to colour as well as quality. Specifications for packing and marking are also included.

In accordance with the procedure of the Indian Standards Institution, every draft specification or code prepared by a Sectional Committee or Sub-Committee, after its approval by the Sectional Committee, is to be issued in proof form for a period to be determined by the Committee, but not less than three months, and widely circulated amongst those likely to be interested, for the purpose of securing critical review and suggestion for improvement. Comments received from all quarters will be given due consideration by the Sectional Committee; and the revised final draft will then be put up to the Textile Division Council for endorsement. Before being finally accepted as an Indian Standard it must be approved by the Executive Committee and the General Council of the Institution.

This draft standard is being circulated among wool producers, exporters, manufacturers and other interests who are likely to be interested in the subject of the standard. Comments will be received till the end of May 1949 by the Director, Indian Standards Institution, Block 11, Old Secretariat, Delhi 2.

COVER ILLUSTRATION

A lotus lake at Dosuya,
District Hoshiarpur

—Photo N. S. Bisht

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Parts of the Governor-General's Estate has now come under cultivation. The old-fashioned bullock-plough and the modern tractor are both being used in the Estate. Picture on the reverse shows His Excellency Shri Rajagopalachari at the plough.

INDIAN FARMING

SEPTEMBER, 1949

Vol. X

No. 9

PRODUCE ALL THE FOOD WE REQUIRE*

WHEN I was in Simla last month for a week's holiday, I invited those who expressed a desire to see me to what is called an At Home. In the old days an At Home meant alcoholic drinks. But now of course no such thing is possible. We had some soft drinks and what was permissible under the Entertainment Laws by way of chewing. We had asked everyone who had signed his name without looking into his rank or profession. So that I was able to see the glad faces of nearly fifteen hundred Simla residents that evening.

The report of this gathering in the newspapers alarmed some good men who thought I had called together fifteen hundred men and women and feasted them in old Viceregal Lodge and wasted a lot of food when there was so much talk of shortage and appeals for austerity. They did not know that we spent not one ounce of rice or wheat or millet or of pulses over this Simla At Home. It was indeed a miserable miser's fraud. But this alarm brings to notice once again the anxiety of people over the food shortage in the country. I am not an expert but I think you will listen to me all the same. Do we as a nation wish to live and make our mark as an independent and civilized people? I suppose we do. Well then we must sit up and think this food shortage out and do what logically follows. Otherwise we break.

Money can be printed and during short periods of emergency we can use such printed paper to borrow service and labour to meet the emergency, appearing to pay for them. Later we should gradually withdraw the excess money and restore normality. Excess money in circulation does nobody good. It just raises prices. Money is not wealth. It is just a ratio-tool and a credit-token.

We have to pay for what we import from other countries by producing goods in our own country and exporting them in payment of our dues for imports. Our own paper-money is of no use in this connection. What we get from abroad must be paid for fully, if not now, next year or the year after, if we can get our foreign friends to wait that long. If we get machinery for industries or manufactured articles for use or foodgrains to eat, we must pay back either in services rendered or in raw materials or in manufactured articles or in gold or other precious metals. All these have to be exported in such shapes and kinds as are wanted abroad and are acceptable.

Now it is well known India cannot send much out in these ways. Once upon a time we were growing enough food for our people and were also able to produce certain other raw materials or partially prepared stuff for which there was an eager demand in the foreign countries which supplied us the manufactured articles that we imported. We were exporting raw materials so much that we had an account in our favour as net result. We are importing at present a great quantity of manufactured articles from abroad as well as a considerable quantity of foodgrains. For payment we have been depending on our war-time savings banked in England instead of producing extra goods for export. This is good enough for the time being.

But this cannot go on for ever, can it? We must stop importing to the extent we cannot export. If we do not ourselves stop, it will stop of itself. We must cut our imports down according to what we can now export, and wait for improvement in the latter before we order things from abroad. But whatever we may or may not do, we must eat.

---

* Speech by His Excellency Shri C. Rajagopalachari broadcast from Delhi Station of All-India Radio on 6 July, 1949.

Anything may wait, but not this. We have to produce all the food we require or we invite famine and chaos which will reduce our population. Nature is a relentless accountant and works automatically.

Government programme to build new dams and reservoirs to bring in new areas under cultivation depend on help from abroad in various ways. This again brings us up against problems of foreign exchange, that is, the problem of payment in goods for the expensive machinery and services that we have to import from abroad. Government try to get these things on credit and are doing their best.

These and other large problems are being tackled by our Government who are doing the utmost they can. Foreign Governments also have not been ungenerous or unhelpful. They are indeed doing all they can to help us because they know India is a great country with plenty of natural resources as well as a very brainy industrious population, and so India is sure one day to be a great and valuable unit in the civilized world. Our brains and our working capacity, which together form the principal element in wealth, are quite good in quantity and quality. Everyone in the world admits this. We cannot however fulfil these high expectations unless we in the meanwhile produce enough food to live and work efficiently. Even if we are unable to do much at once in the way of producing manufactured articles in surplus for export, we ought to grow all the food we require.

We are a rice-eating people. We also consume a large quantity of wheat. We cannot easily and at once expand the area under rice cultivation. The shortage in one kind of food can be made up by another if we know how to adjust ourselves. We cannot afford to sit still until irrigation schemes for increased rice cultivation are completed. We must grow such things as can be immediately grown by way of food, whatever they may be. We can produce more millet and pulses and tubers than we do now. We must raise poultry for eggs and grow fish in our ponds and fruit and vegetables in our house-yards and make up for shortage in calories.

The standard of life among the working classes has gone up. It *must* go up and it is well that it has gone up. The peasants and landless rural labourers who used to eat *ragi*, maize or millets, and ate rice only on festive and rare occasions, now eat rice generally and are not happy unless they get it. Besides the change-over in habit, population has increased. There is thus on the whole a great increase in consumption of rice. This is as it should be. But it is not altogether good. In the first place a pure rice diet is not so good for health as it may be for taste. But apart from this we have as a result gone short of rice. We cannot easily expand the area of rice cultivation, for it requires dams and canals which involve vast expenditure and cannot be got ready quickly. We can however raise more millet and pulses and tubers without large irrigation projects. It is therefore desirable that the fashion must be set for greater consumption of *ragi*, *cholam*, maize and millet. Nothing can be done by way of setting a fashion except by the so-called upper classes. What they do is eagerly copied by others. Like jail-going, hobnobbing with outcastes, spinning, wearing Gandhi-caps, millet-food must be made a patriotic high class fashion. This will lighten the present load on rice.

This great mother, the ground on which we walk and live, is a wonderful mother, most generous, most forgiving and most skilful. Put anything into it, be it the worst rotten stuff, mere offal or what we throw out as excrement, this ever-loving sleepless mother converts it for us by an alchemy of her own into rich food which shoots up, juicy and fragrant. But she requires a little help from us, just a little help and some watchful cooperation. You must know what to sow as seed and when, and look after the shoots that come up. The earth returns with interest what you put in. Receiving offal and excrement, she gives us back pumpkins, cucumbers, bananas, whatever we know how to raise.

Urban authorities should consider it their sacred obligation to collect and conserve town refuse and make good manure out of it and place it at the disposal of gardeners and cultivators of land at a reasonable price. People gather more and more into urban areas and it is the duty of the civic authorities to remember their obligations to the rural areas that feed the towns and return at least in part the nitrogen that flows into the urban areas. This can be done by careful conservation and disposal of the organic refuse of the towns. Apart from animal droppings, what is thrown out by townsfolk is a continuous and considerable drain on the rural areas unless there is an organized movement of manure from towns to villages.

What is required is increased interest in raising something by way of food wherever you can and whatever it may be. Now, who is to go round and tell people all this and not only tell, but make people do it? Who did it for weaving and spinning? Who did it for Hindu-Muslim unity? Who did it for removing untouchability? Who did it for fighting the drink-evil? Not Government anyway! The people organized themselves under Congress direction. Government did not and would not do it in the days that are past. Now however Government are not against the people. They are with the people. But Government cannot do some things. They cannot do what individuals and organized groups of individuals can alone do. Officials cannot effectively spread themselves over the vast country and even if they could, it would cost so much that it is impossible. An unofficial nation-wide movement alone can do it. Government will help, but self-help and patriotism produce more than official patronage or interference.

I am speaking frankly and as a citizen. During these last sixty years, whenever there was a great national movement needed in India, the Congress undertook it and did it. The Congress in constructive work is not a party. It is the aggregate of disinterested energy that belongs to the whole nation. In its *khadi* work, in its Harijan work and in all its other constructive work in the past, everyone that was ready and willing to help was welcome to join. While Congress took up responsibility, it did not exclude anyone.

Congress can lead a movement for food-growing and save the country from bankruptcy. But it can succeed only if the people cooperate with fanatical zeal in this as they did in other things during the last three decades. It will be a glorious achievement and pave the way for the fulfilment of all our other aspirations.

Original Articles

COLLECTION, ACCLIMATIZATION AND TRANSPORT OF THE FRY AND FINGERLINGS OF THE MILK-FISH, *CHANOS CHANOS* (FORSKAL)

By V. RANGANATHAN and S. V. GANAPATI

THE importance of 'increasing variety with bulk' of the food fishes of Madras has been emphasized by Job and Chacko[1]. The milk-fish, *Chanos chanos*, which is prized as one of the chief coastal food fishes on account of its delicate flavour, not only grows quickly to about 25 in. in a year in freshwater[2], but also its fry and fingerlings are available in abundance from the mud flats in and around Krusadai Island (Gulf of Manaar), in the tidal creeks near Pamban, Ramnad District, in Adyar and Ennore Estuaries, Chingleput District and in the tidal pools near Malpe on the West Coast. They have been collected and transported annually after conditioning and rough acclimatization for stocking cultivable inland waters by the Madras Government Fisheries Department only in very recent years.

Earlier attempts.

As far as the authors are aware, there are no published accounts portraying accurately the conditions under which the fry are collected and acclimatized in the field and transported inland, except the following :

(a) The first attempt to transfer 500 fry from the swamp to a large natural pond at Thonithurai was made in 1931-32[3].

V. RANGANATHAN, M.SC., and S. V. GANAPATI, B.A., M.SC., A.R.I.C., belong to the Fisheries Department, Government of Madras.

(b) '.........Attempts were made in the past to introduce them into the Ippur Fish Farm, but they were not successful as the fry were collected from the neighbouring highly concentrated saline channels in salt creeks, the salinity of which was far higher than that even of the sea and therefore scarcely any survived after their introduction into the pond. An attempt was made during the year under report to rear this fish in the farm and 755 fingerlings were brought from Krusadai Island and introduced into the pond. If, as is expected, the experiment proved a success, it will be extended to other waters'.[4] In the subsequent annual reports of Dr Sundar Raj, the then Director of Fisheries, Madras, no mention is made about the failure or success of the above experiment.

(c) Chidambaram and Unnie[2] have stated that 'the technique of acclimatizing and conditioning milk-fish fingerlings for transporting and stocking in fresh waters has been perfected at Krusadai ', but there is nowhere any record describing the technique. Therefore, an attempt has been made in this paper to place on record how during the fry season of 1948, a record collection of about one lakh of fry was made, acclimatized and transported to other fish farms and ponds in the interior with very slight mortality in a few cases only. In several instances, the transported fry were followed and the water was examined for temperature, pH, chloride content; condition of the fry and mortality at wayside stations and at their destination several hundreds of miles away from Pamban were also noted. Since acclimatization of the salt water fish seeds to fresh water in the shortest possible time and with the least percentage of mortality is of considerable economic importance especially at the present time, our attention was mainly directed to that end in all our field experiments.

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[1] Job, T. J. and Chacko, P. I. (1947). Rearing of Salt-water Fish in Freshwater of Madras, *Indian Ecologist*, Vol. 2, No. 1, pp. 1-9.

[2] Chidambaram, K. and Unnie, K. M. (1946). Variations in the Rate of Growth of the Milk-Fish *Chanos chanos*, *Nature*, 157; No. 3986, p. 375.

[3] Sundar Raj, B. *Administration Report of the Madras Fisheries Department*, 1931-32.

[4] Sundar Raj, B. *Administration Report of the Madras Fisheries Department*, 1939-40.

Details of 1948 attempt

Preliminary arrangements: Since the *Chanos* fry are known to appear in large numbers from April to August every year, in the tidal creeks near Pamban, the collection grounds were inspected as early as 11 March, 1948 and arrangements were made with a local fisherman for supplying conditioned and acclimatized fry under departmental supervision at the rate of Rs. 10 per 1,000 for delivery in the train at the Pamban junction. Further, a nursery measuring 100 ft.×25 ft.×3 ft. was constructed close to the shore in Pamban for stocking all the collected fry during the course of the day by the contractor. The nursery was connected to the sea during high tide so that fresh sea water was entering it every day, to offset the loss due to evaporation. Another private pond was also requisitioned for stocking and conditioning them in case of necessity.

Commencement of the fry season: The first appearance of the fry was noticed on 2 April and in a few days thereafter the contractor had stocked the nursery with 5,000 fry varying from half to one inch in size. The fry collection season lasted exactly for three months from 4 April to 4 July during which period more than one lakh fry was collected.

Establishment: The Assistant Inspector of Fisheries at Manamadurai (Ramnad District) was placed in charge of the work who was helped by two fieldmen. One of them was deputed to look after the collection of the fry while the other was in charge of the important work of acclimatization and transport.

Fishery equipment: Three conditioning boxes and 163 round tin carriers were used for the purpose. The Assistant Directors of the several divisions in the province were requested to place their indents for the required number of fry and to send their own tin carriers in good condition for ready transport and they readily responded to the request.

Collection of the fry: The flat sandy regions all round the island furnished the largest catch. The fry were seen in vast shoals when they were usually caught by batches of women workers consisting of five workers. Two of the workers waded each batch through ankle deep water carrying the two ends of a *saree* measuring 10 ft.×4 ft., holding it loosely above the water surface. Another pair dragged under water a coir rope about 10 ft. in length with palmyra leaves attached all along its length, just in front of the cloth. The rope was touching the bottom, so that the fry in fright leapt into the cloth behind from which they were removed carefully to a tin carrier carried by a fifth woman, containing sea water. When a tin carrier contained about 500 fry it was taken immediately to the nursery where they were emptied. In this way the contractor was able to collect every day about 5,000 to 10,000 fry.

Till the second week of May 1948 collections were made in the creeks near Chinnapalam; later from a place called Kallingal, a railway bridge over a creek situated between Pamban Railway Station and Rameswaram. From the first week of April to the the first week of May was the peak period of collection. There was a second smaller maxima in the third week of May in the creeks near Kallingal. In this manner over 100,000 fry were stocked in the nursery.

One day unfortunately, a serious depletion of the fry was caused by the entry of predators locally called *keeli*, a cat-fish, into the nursery. Fortunately they were netted and removed in time without much loss.

By the end of June, fingerlings measuring 3 in. to 4 in. were available, and, as their collection was not considered economical, the operation had to be stopped, although fingerlings were available in thousands till the first week of July.

Conditioning and acclimatization

After stocking in the nursery, the fry required for transport on the next day were collected from the nursery in the same manner as described above for collecting them from the mud flats, counted and kept in a condition box in lots of 2,000 in the evening at about 6 p.m. prior to their despatch on the following day.

From the condition box the fry were taken at about 7 a.m. on the next day and kept in tin carriers in lots of 200 or 100 depending upon the size. If the fry were about half to two inches, then 200 could be taken and if over that size, about 100 in each tin. The tins were filled to a third of their height with four buckets of water amounting to about 1·4 gallons from the nursery to begin with. They were taken next to a cocoanut tope where there is a well containing freshwater, which is used by the people of the locality for drinking purposes.

On reaching the well in the tope, one bucket of water from each tin was removed and was replaced by one bucket of well water. This operation was repeated three times without allowing any definite time interval after each dilution. On the fourth occasion all the water in the tins was replaced by fresh well water and the tins were taken to the Pamban Railway Station where one more bucket of fresh water was added from the well near the station. Finally, just before loading the tins into the railway van, three buckets of water were removed from the tin and were replaced by two buckets of fresh well water. Samples of water were collected from different situations during one such operation on 8 May, 1948 and examined for temperature and chlorinity. The results (Table I) are the averages of three separate tins used for each experiment.

TABLE I

Percentage of reduction of chlorinity and mortality during process of acclimatization

Description	Time	Temperature C.	Dilution in terms of buckets	Chlorinity (parts per 100,000)	Percentage of reduction in chlorinity	Condition of fry	Percentage of mortality
1. Nursery water (A)	7.40 a.m.	29·4	4 A	2620·0	—	Good	*nil*
2. Well water (B) (Cocoanut tope)	8.00 ,,	30·2	—	40·0	—	—	—
3. do. Pamban Railway Station (C)	12.20 p.m.	31·8	—	80·0	—	—	—
4. Total water	(1·4 gallons)		4 A	—	—	—	—
1st dilution	8.45 a.m.	30·2	−1A+1B of second dilution	1975·0	24·7	Good	0·2
2nd ,,	9.50 ,,	30·4	−1+1B of second dilution	1491·0	43·9	,,	*nil*
3rd ,,	10.40 ,,	30·8	−4+4B	40·0	98·5	,,	,,
4th ,,	11.35 ,,	31·0	4+1C	60·0	97·7	,,	,,
5th ,,	12.20 p.m.	31·2	−3+2C	70·0	97·3	,,	,,

It will be seen from Table I that except for a mortality of 0·2 per cent in the first dilution which might have been to due accidents during transfer, there was practically no mortality at all when the percentage of reduction of chlorinity was 98·5 in the third dilution. Secondly, the entire process of acclimatization was over in about five hours during which the fry varying in numbers from 6,000 to 91,000, were acclimatized practically without any mortality. Thus 24 hours were taken for conditioning and about six hours for acclimatization.

In Table II is given the total number of fry acclimatized and transported in the manner described above on the various dates noted against each during the season.

TABLE II

Number of fry of milk-fish Chanos chanos *booked from Pamban Railway Station*

Serial number	Date	Destination	No. of tins	No. of fry	Total
1	12-4-48	Assistant Director (I) (Development), Madras	12	1,600	..
2	,,	Assistant Fishery Demonstrator, Palghat	8	4,400	6,000
3	15-4-48	Chettinad	7	1,200	10,200
4	16-4-48	Assistant Fishery Demonstrator, Palghat	8	3,000	10,200
5	17-4-48	Inspector of Fisheries, Vellore	12	3,000	13,200
6	,,	Assistant Fishery Demonstrator, Palghat	10	4,200	17,400
7	18-4-48	do.	10	3,400	20,800
8	20-4-48	do.	6	1,500	22,300
9	21-4-48	do.	10	3,500	25,800
10	22-4-48	Adirampatnam	4	600	26,000
11	23-4-48	Chettinad	10	5,000	31,400
12	25-4-48	Inspector of Fisheries, Vellore	12	4,400	35,800
13	27-4-48	Assistant Fishery Demonstrator, Palghat	15	5,500	41,300
14	29-4-48	Fishery Demonstrator, Trichinopoly	6	2,100	43,400
		Kulitalai	2		
		Manaparai	1		
15	,,	Palghat	15	7,850	51,250
16	2-5-48	Fishery Demonstrator, Coimbatore	15	5,200	56,450
17	5-5-48	do.	15	1,900	58,350
18	8-5-48	do.	15	3,000	61,350
19	9-5-48	Fishery Demonstrator, Madura	10	2,000	63,350
20	13-5-48	Assistant Inspector, Chidambaram	6	700	64,050
21	14-5-48	Assistant Director (I) (Development), Madras	9	1,100	..
22	,,	do. Fresh Water Research, Madras	5	600	65,750
23	25-5-48	Chettinad	10	2,500	68,250
24	26-5-48	do.	10	6,000	74,250
25	28-5-48	Chidambaram	10	3,250	77,500
26	29-5-48	Assistant Director (I) (Development), Madras	10	3,500	81,000
27	31-5-48	do. Fresh Water Research, Madras	9	2,500	83,500
28	5-6-48	Chingleput	5	3,000	86,500
29	7-6-48	Chidambaram	6	3,000	89,500
30	10-6-48	Inspector of Fisheries, Mettur Dam	9	1,500	91,000
31	11-6-48	Assistant Driector (I) Development, Madras	11	1,000	92,000
32	14-6-48	Chingleput	10	1,300	93,300
33	21-6-48	Assistant Fishery Demonstrator, Palghat	10	700	94,000
34	23-6-48	Assistant Director (I) (Central), Madras	12	600	94,600
35	25-6-48	Assistant Fishery Demonstrator, Chettinad	10	1,000	95,600
36	28-6-48	do.	5	900	96,500
37	1-7-48	Fishery Demonstrator, Madura	10	400	96,900

Two facts will have to be mentioned in connection with the transportation of *Chanos* fry to our fish farms all over the Presidency. Due to a lightning strike by the railway running staff, the demands of all officers could not be met. Further, indents for *Chanos* came pouring in towards the close of the season. So, if in the following year, indents are placed with the Assistant Director, R.F.D., Coimbatore, sufficiently early in the second week of March along with the tins, it will be possible to collect and transport several lakhs of fry from this source alone.

Mortality in transit and at destination

Mortality of *Chanos* in transit or at destination was recorded in a few cases only and on the basis of these figures (Table III), it may be stated that the maximum percentage of mortality was about 2·5.

TABLE III

Percentage of mortality in transit of Chanos chanos.

Date of booking	No. booked	Destination	No. received	Percentage of mortality
16-4-48	3,000	Palghat	2,980	0·66
21-4-48	3,500	do.	3,416	2·4
29-4-48	2,100	Trichy	2,100	Nil
2-5-48	5,200	Coimbatore	5,100	0·8
9-5-48	2,000	Madura	1,978	

There were a few exceptions when heavy mortality was also recorded due to exceptional causes:

(a) Sixty per cent mortality of a consignment received at Coimbatore was due to the negligence of the Fishery Demonstrator's unit at Madura in not changing the water at the proper time and to the holding up of the tin carriers in a parcel van.

(b) Over 60 per cent of mortality was reported by the Assistant Director, Fresh Water Research, Madras, for want of proper intimation at the destination and to the consequent delay in taking delivery of the consignment.

(c) A third consignment booked to Madura resulted in 75 per cent mortality due to the well water containing H_2S which was used in Pamban for the final dilution. So it is essential that the water used for dilution should be free from H_2S and other poisonous gases or substances.

Examination of fish consignments in transit

On 5 May, 1948, fifteen tins containing 1,900 fry on their way to Coimbatore were examined at about 9 p.m. at Madura Railway Station. The tins were examined in the van. The temperature of water in the tins varied from 30° to 31·2° C. and water samples from two of the tins which were examined gave the following results of analysis.

	Tin A	Tin B
	Parts per 100,000	
Free carbondioxide ...	*nil*	*nil*
Carbonates ...	0·9	0·9
Bicarbonates ...	47·215	49·105
pH	8·1	8·0
Dissolved oxygen (c.c.)	0·551	0·206
Chloride	480·0	390·0

It will be seen from the above random sampling that the chloride content of the water in the tins was still high so as to call it brackish and not fresh water even after dilution at Madura. It is therefore considered essential that in future when tins are despatched from Pamban, the chloride content must be estimated by a rough and ready method, to ensure that it will be less than at least 50 parts per 100,000. Steps are being taken for this purpose for adoption in the following years.

Experiments on acclimatization

It is stated elsewhere that the total time usually taken in the routine process of acclimatization was about six hours after conditioning for about 24 hours. Four experiments were carried out in the field to study the results when the whole process of acclimatization from salt to fresh water was done at intervals of three hours, two hours, one hour and immediately in three or four stages of varying dilutions. Three tins each containing 100 fry varying from ½ to 2 in. were used for each of the first three experiments. Each tin contained four buckets of the nursery water (with a chlorinity of 2,620 parts per 100,000 which was equivalent to 1·4 gallons). The well water used for dilution contained 40·0 parts per 100,000 of chlorine.

First experiment: Three tins A, B and C were used in this experiment and the dilutions were effected in the following manner at three hourly intervals.

Tin A: The first change was made by removing one bucket of the nursery water with a chlorinity of 2,620 parts and replacing it by an equivalent amount of fresh well water of 40·0 parts per 100,000 of chlorinity and the dilution amounted to one part of fresh water to three of salt water. The second change was made after an interval of three hours, when two buckets of water were removed from the tin and were replaced by an equivalent amount of fresh well water and the dilution amounted to two parts of fresh water to two of the diluted salt water of the first change. The third change was made again after an interval of three hours when three buckets of water were removed from the tin and were replaced by three buckets of fresh well water which amounted to three parts of fresh water of one of the diluted salt water of the second change.

The results of this experiment are shown below:

Tin	Ratio	Temperature	Chlorinity: parts per 100,000	Percentage of reduction	Percentage of mortality
	F : S				
	1 : 3	31·6°C.	1,975	75·39	1·00
A	2 : 2	33·0 ,,			
		32·0	1,008	41·22	*nil*
	3 : 2	33·0 ,,	282	8·55	,,
		31·4			

F= Fresh water S= Salt water

Tin B: In the first change, two buckets of water were removed from the tin and were replaced by an equivalent amount of fresh well water amounting to a ratio of 2 of fresh water to 2 of salt water. The second change was made after an interval of three hours when three buckets of water were removed and were replaced by an equivalent amount of fresh salt water. This dilution was equivalent to a ratio of 3 of fresh water to 1 of the diluted salt water of the first change. In the third change, the entire water in the tin was replaced by fresh well water. The results of this experiment are as shown below:

Tin	Ratio	Temperature	Chlorinity: parts per 100,000	Percentage of reduction	Percentage of mortality
	F : S				
B	2 : 2	31·0 °C.	1,330	50·77	*nil*
	3 : 1	32·2 31·6	362·5	13·84	,,
	4 : 0	32·2 31·6	40·0	1·53	,,

Tin C: The first change was made by removing three buckets of the nursery water from the tin and replacing it by an equivalent quantity of fresh well water. The resulting dilution worked to a ratio of 3 parts of fresh water to 1 of salt water. After an interval of three hours, the second change was made by replacing the entire water in the tin by fresh well water. The results are given below:

Tin	Ratio	Temperature	Chlorinity: parts per 100,000	Percentage of reduction	Percentage of mortality
	F : S				
C	3 : 1	30·6° C.	685	26·14	*nil*
	4 : 0	31·6			
		31·2	40·0	1·53	,,

Second experiment: This was exactly similar to the first experiment with the important difference that the dilutions were effected after an interval of two hours in each of the three tins D, E and F. The results are recorded below:

Tin	Dilution	Temperature	Chlorinity: parts per 100,000	Percentage of reduction	Percentage of mortality
	F : S				
C	1 : 3	31.8 °C.	1,975	75.39	
	2 : 2	32.1/31.2	1,008	41.22	
	3 : 1	31.8/31.4	282	8.55	*nil*
	4 : 0	32.0	40	1.53	
D	2 : 2	31·2	1,330	50·70	
	3 : 1	31.8/31.3	362·5	13·84	*nil*
	4 : 0	31.6 31.2	40	1.53	
E	3 : 1	31.6/31.2	685	26.14	
	4 : 0	31.4 31.2	40	1.53	*nil*

Third experiment: This was also exactly similar to the first two experiments with the important difference that the dilutions were effected after an interval of one hour. The results of this experiment are recorded below:

Tin	Dilution	Temperature	Chlorinity : parts per 100,000	Percentage of reduction	Percentage of mortality
	F : S				
F	1 : 3	31·6°C.	1975	75·39	*nil*
	2 : 2	31·8/31·4	1008	41·22	,,
	3 : 1	31·8/31·3	282	8·55	,,
	4 : 0	31·2/31·2	40	1·53	,,
G	2 : 2	31·2	1330	50·77	,,
	3 : 1	31·7/31·2	362·5	13·84	,,
	4 : 0	31·2/31·2	40	1·53	,,
H	3 : 1	30·9	685	26·14	,,
	4 : 0	31·4/31·2	40	1·53	,,

Fourth experiment : In this experiment, 17 fingerlings of *Chanos* measuring about 4·2 in. in length were used. The nursery water was completely replaced four times by fresh well water after intervals of ten minutes on each occasion, when there was not even a single mortality. The temperature of the nursery water was 35·0°C. and that of the well water was 31·2°C.

Conclusion

It will be seen from the above that the fry and fingerlings of the milk-fish *Chanos chanos* can be easily acclimatized to freshwater without resorting to the time-consuming process of reducing the salinity in gradual stages. The knowledge that this important salt water fish could withstand even direct transference from salt to fresh water, has a vital bearing on the possibilities of their culture in inland waters.

THE COORDINATED RESEARCH ON THE WASTE PRODUCTS OF COFFEE

IT was known for a long time that the pulpy residue from the coffee bean was a good feed for cattle. It remained a waste product for the simple reason that cattle did not like the taste of it, and therefore would not eat it. At a cooperative experiment station in El Salvador, American and Salvadorean researchers, by experimenting with additional ingredients, evolved a formula that made the material palatable to milch cows. The waste material can now be used as a substitute for corn. If all the coffee pulp in Latin America were converted to cattle feed, a not impossible task, it would provide the equivalent of about 34 million bushels of corn a year. Such an achievement would be significant for both the health and economics of the Latin American countries, which are now producing only a small percentage of the milk their peoples need. (R.S.)

MALT INDUSTRY IN MADRAS

By A. SANKARAM

MANY people are well acquainted with products of the types of Benger's Food, Mellins Food, Horlicks Malted Milk, Grapenuts and Malt Extract. They are foods predigested by a series of chemical and bio-chemical processes in the factory and put up in a form in which they are easily digested and assimilated by infants and people with weak digestive power. They are therefore styled as infant and invalid foods. The basis of all these foods is malt, a product usually prepared from barley, which is not cultivated in South India except on the Nilgiris. The malting of a variety of cereals produced in South India as a substitute for barley with a view to make infant and invalid foods was the object of an investigation started by Mr. B. Viswanath (now Rao Bahadur Dr B. Viswanath, C.I.E., D.Sc., F.R.I.C.) and his colleagues in the chemical laboratory of the Government Agricultural Chemist, Coimbatore. *Sorghum* (Hindi : *Jowar*, Tel : *Jonna*, Tamil : *Cholam*) was found to be the best among the cereals tried closely followed by *ragi* (*Elusine coracana*).

Early history

At the instance of the Indian Munitions Board the investigations on the malting of *Sorghum* were continued in greater detail in the year 1923. An examination of 18 varieties of *Sorghum* with regard to their suitability for malting revealed that the best of them gave almost the same kind of extract as barley. Further the optimum conditions of steeping, couching and drying were studied and a detailed comparison of the action of *Sorghum* and barley malt extracts on starch was made. Studies on the hydrolysis of starch by *Sorghum* malt indicated that certain varieties of *Sorghum* gave practically the same extract as barley used as control, and that there was wide scope for the use of *Sorghum* in the preparation of malt foods.

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Work by the Industries Department

In 1922, the Department of Industries, Madras interested itself in the problem of preparation of malted foods. An Industrial Chemist was appointed to investigate the possibilities of large scale operations with *Sorghum*. The scope of inquiry was limited to (i) the lowering and control of temperature at Coimbatore and (ii) successive production of malts of fairly uniform quality from bag-lots of *Sorghum*. The experiments were conducted on a semi-industrial scale using lots of 1 cwt. of *Sorghum* which could be easily handled by a small factory. The results of the investigations justified the conclusions that it was possible to produce successive lots of malt of uniform quality under Coimbatore conditions and that about the same percentage of extract could be got from *Sorghum* malt as from barley malt. The results of these experiments were embodied in *Bulletin of the Department of Industries and Agriculture*, No. 1, 1925.

Chemical aspects of malt-making

Having thus demonstrated the possibility of manufacturing on a large scale from *Sorghum* grain a malt food, which was suitable for infants and invalids and could effectively replace the huge imports of similar foods from abroad, it was thought desirable to conduct further researches on the chemistry of malt-making. Standardization of the technique of malting to obtain a malt of superior and uniform quality formed the work of prime importance. The results of trials in this direction finally indicated that steeping the grain for 24 hours, couching over a week and kilning at a fairly low temperature of 70°C. for longer periods and the use of polishing machine designed by the Research Engineer, Coimbatore, were essential to achieve the desired results.

Studies on lintner value of malt food

The lintner value of a malt is the measure of the capacity of the enzyme contained in the cereal to convert insoluble starch into soluble sugar, maltose. It is therefore not a measure of the digestibility of the food but only a measure of the power to render the insoluble starch into soluble and an easily assimable sugar. A malt food with high lintner value is therefore valuable in so far as it is potentially a supplier of large quantities of soluble sugars. One way of increasing this value with *Sorghum* is to attempt to prolong the period of couching, i.e. by suppressing the germination by lowering the temperature during couching. *Sorghum* grains after steeping were placed in a cold chamber and samples drawn every other day for analysis of lintner value. It was seen that by prolonging the period of couching under low temperature of 66° F. the lintner value rose from 9·8° L on the fourth day to a value of 20·4° L on the eighth day—this value being the maximum and thereafter the value remained steady or tended to deteriorate. In the case of *ragi* (*Elusine coracana*) the value is always low (6·3 to 8·3° L), lowest in white *ragi* (5·3° L), and does not seem capable of improvement. With wheat high values (40 to 45° L) can be obtained even with much shorter periods of couching than *Sorghum*. This is probably the reason why wheat malts are used extensively in the preparation of malt foods covered by patents. The malt food powder after partial roasting even under controlled conditions of slow roasting in a current of air resulted in considerable fall in the lintner value; a malt of about 20·0° L had a value of about 8·0° L. It is interesting to note, however, that certain well-known proprietary malt foods had even lower values as determined from locally purchased samples as given below:

	Type of food	Diastatic value: degrees L
1	Malted milk type	4·4
2	Malted milk type	2·5
3	Composite malt egg type ...	27·1
4	Composite milk cocoa egg type	47·2
5	Malted milk type	1·9

After the termination of the scheme of work financed by the Indian Council of Agricultural Research in 1938-39, it was continued as a part of the work of the Chemical Section under the direction of the Government Agricultural Chemist. The first step was to follow up the recommendation of Sir John Russel[1] that medical opinion should be sought on the suitability of *Sorghum* malt for infants and invalids by actual clinical tests before it was offered to the public for general use. Accordingly malt food was supplied to 27 hospitals and clinics (Government-owned as well as private) in the province and the opinions obtained therefrom were in general very encouraging in that the malt food was as much relished by invalids and infants as of the foreign products under common use at that time. The clinical reports also indicated that malt food was specially useful in gastro-intestinal disorders.

Large-scale developments of the industry

The Government of Madras was pleased to sanction in the first instance the construction of a pilot plant of capacity of 150 lb. of malt food per month. Encouraged by the results that emerged out of this trial, production of malt food on a commercial scale in a factory rated to produce 36,000 lb. per annum was started. The factory was put in the charge of a business manager and has been in operation from that day.

Malt extract—its preparation

The possibility of making malt extract out of *Sorghum* and *ragi* malts has been the subject of study in the laboratory of the Government Agricultural Chemist for some years past. Originally the making of the extract was confined to the coarse malt meal, cold and hot water extraction, filtration and concentration in vacuo. This process gave a dark coloured viscid liquid with a caramalized flavour which would detract from its value in the market as a substitute for imported malt extracts. By a modification of the technique which consists in filtering through active carbon before concentrating in vacuo, it was possible to get a honey-coloured translucent viscuos liquid extract which was free from caramalized flavour. By fortification of this extract with vitamin A in the shape of high potency shark liver oil, it was possible to obtain a product which compared favourably

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[1] Russel, Sir John. *The Work of the I.C.A.R. in Applying Science to Crop Production.*

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with imported patent preparations like Kepler's cod liver oil with malt extract. The preparation of malt extract of good quality having proved a success on a laboratory scale, a pilot plant for its preparation on a large-scale was set up in 1942. The working of this plant fully justified the production of the extract and its products on a factory scale similar to that of malt food. The installation of a factory capable of producing 15,000 lb. of malt extract per annum, was sanctioned by the Government in 1942. These units came into operation and malt extract of excellent quality with and without shark liver oil has since then been produced by the factory in large quantities. The production readily answered the needs of the Defence Services during the war and civil demand is being sought for now.

Government Malt Factory, Coimbatore

The Government Malt Factory at Coimbatore consists of two working units, one for the production of malt food and the other for malt extract. *Sorghum* grain is the basic raw material for the said purpose. Under special refrigeration rooms couching or germination of the grain is carried out at temperature of 65°F. for a period of one week to ten days. The grain is then sun-dried and passed through definite stages, i.e. polishing, roasting, grinding and sieving. The coarse meal that does not pass through 100 mesh sieve is known as the coarse malt and is used for the manufacture of malt extract. A yield of 20 to 25 per cent of the malt food is normally obtained from good grain of *Sorghum*. A set of three polishers, six roasters, three grinders, and three sieving machines are set up in the factory which is rated to produce 300 lb. of malt food per day. The food is packed in one pound bottles and sealed in carbondioxide gas.

The malt extract plant has a maximum capacity of 250 lb. of malt extract per day. The equipment consists of a battery of six steam jacketed pans (50 gallons capacity), a set of six centrifuges, six vacuum filters and six vacuum stills (50 gallons capacity). An electrically-driven stirrer is used for the complete fortification of the extract with shark liver oil. The process of preparation of the extract in brief is as follows. Fifty pounds of the green malt and 50 lb. of coarse or roasted malt are mashed in each pan with 40 gallons of water at 60°C. for three to four hours to complete diastatic break down of starch. The supernetant liquid is first drawn off and the thick liquid remaining in the mash tub is centrifuged and the centrifugal liquid is filtered under suction through a bed of active carbon. The clear filtrate obtained therefrom is changed into the vacuum still where it is concentrated at 62° to 65°C. and it takes nearly 16 to 20 hours for the extract to attain the desired consistency. The final extract thus obtained is of a rich honey colour, viscuos and palatable. It has a specific gravity of 1·4 to 1·45 and a refractive index of 1·4950 to 1·500 and contains 70 to 75 per cent of sugar as maltose. This extract known as the plain extract is mixed with high potency shark liver oil to give about 200 I.U. of vitamin A per gm. and is bottled in one pound amber or green coloured bottles. The yield of the extract is usually 25 to 30 per cent.

Popularization of malt food

Side by side with the work of malt-making on a factory scale, work was also in progress on the manufacture of malt from *Sorghum* grain suitable for small-scale production. The method in essence is the same as that used for large-scale production but all the operations are carried out with simple equipment such as buckets, hand sieves, hand roasters and charcoal fire. This cottage industry method has been widely demonstrated and is in use in Chittor District of the province.

Acknowledgments

To Sri P. Venkataramiah, M.A., B.Sc.(Edin.), who as Government Agricultural Chemist and Principal of the Agricultural College, Coimbatore, was personally engaged in research during the developmental stages of investigation on malting and its translation into an industry, I am deeply indebted for the privilege of working under him and wish to express my sincere gratitude for the very kind direction given in the preparation of this paper.

HYBRID BRINJALS GIVE INCREASED YIELDS

By B. P. PAL and H. B. SINGH

IT is common knowledge that when two varieties of a plant are crossed with each other, the hybrid plants are sometimes more vigorous than the parent plants. Experiments conducted at the Indian Agricultural Research Institute, New Delhi, have shown that this vigour, or hybrid vigour as it is called, occurs in the brinjal to a marked degree and is capable of exploitation for commercial purposes. One hybrid in particular to which the name 'Pusa Purple' has been given, has done extremely well under New Delhi conditions. Daskaloff[1] in Germany and Kakizaki[2,3] in Japan investigated the utilization of hybrid vigour in brinjal and observed that the use of hybrid seed was a practical proposition. In India Venkataramani[4] working on brinjals in Madras reported the manifestation of hybrid vigour by certain intervarietal hybrids but no definite recommendations were made regarding its commercial utilization.

Because hybrid vigour is at its maximum in the first generation and rapidly declines in the following generations, the cross has to be repeated each year and, therefore, the seeds produced by the hybrid plants should not be used. There has been an increasing demand for the seeds of 'Pusa Purple'. It has, however, not been possible to meet the whole of this demand for the crossed seed because up to now the seeds have been produced for experimental purposes only. As the technique of crossing for producing hybrid seed is a simple one in the case of the brinjal, it would be easy to produce hybrid seed at Government Farms or even by private individuals. Small quantities of seeds of the parent varieties could be supplied to those interested by the Division of Botany. Since a single 'crossed' fruit will give anything from 500 to 1,000 seeds, sufficient to plant 0·2 to 0·4 acres, a few successful crosses would be enough to meet requirements in most cases.

Description of 'Pusa Purple' and its parent varieties

The hybrid 'Pusa Purple' is a cross between 'Muktakeshi,' a semi-erect variety with purple flowers and deep purple, rather longish fruits in clusters of two to five, and 'Clustered White', a low-growing variety with white flowers, white medium-long fruits, broader in the middle, borne in clusters of three to six. The latter is an earlier fruiting variety than 'Muktakeshi'. 'Pusa Purple' is conspicuously vigorous resembling 'Muktakeshi' in general habit; the flowers and fruits are purple though intermediate in intensity of colour (Fig. 1). The fruits are long and even when harvested after they have grown to a big size, they are found to contain only immature seeds inside at this stage; consequently they are free from seediness—a defect rather common in brinjals. The hybrid plants begin to bear fruits about 75 to 85 days after sowing, and are earlier than the parent varieties. Under Delhi conditions the frosts damage the crop sometimes at the end of December or the beginning of January when the hybrid plants are still giving quite good yields. If there is no frost the plants will continue to yield for about four months after which they can be pruned to give a second crop later on.

To find out the actual increase in yield when grown on a field scale, the hybrid plants were grown along with those of the two parent varieties in randomized blocks, giving a spacing of three feet between the plants each way. The two reciprocal hybrids 'Muktakeshi'× 'Clustered White' and 'Clustered White'× 'Muktakeshi' yielded 21,382·5 and 22,500 lb. per acre respectively whereas the parent varieties 'Muktakeshi' and 'Clustered White' yielded 15,249 and 13,474·5 lb. respectively. The hybrids thus showed 48·8 and 56·6 per cent increase over the higher parent. The crop was raised under average conditions. With better care, such as is usually bestowed on vegetable crops, much better yield can be obtained.

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[1] Daskaloff, C. H. (1941). *Plt. Breed. Abst.* 12 : No. 1224.

[2] Kakizaki, Y. (1930). *J. Heredity* 21 : 253-58.

[3] Kakizaki (1931). *Genetics* 16 : 1-25.

[4] Venkataramani, K. S. (1946). *Proc. Indian Acad.* 23 : 266-73.

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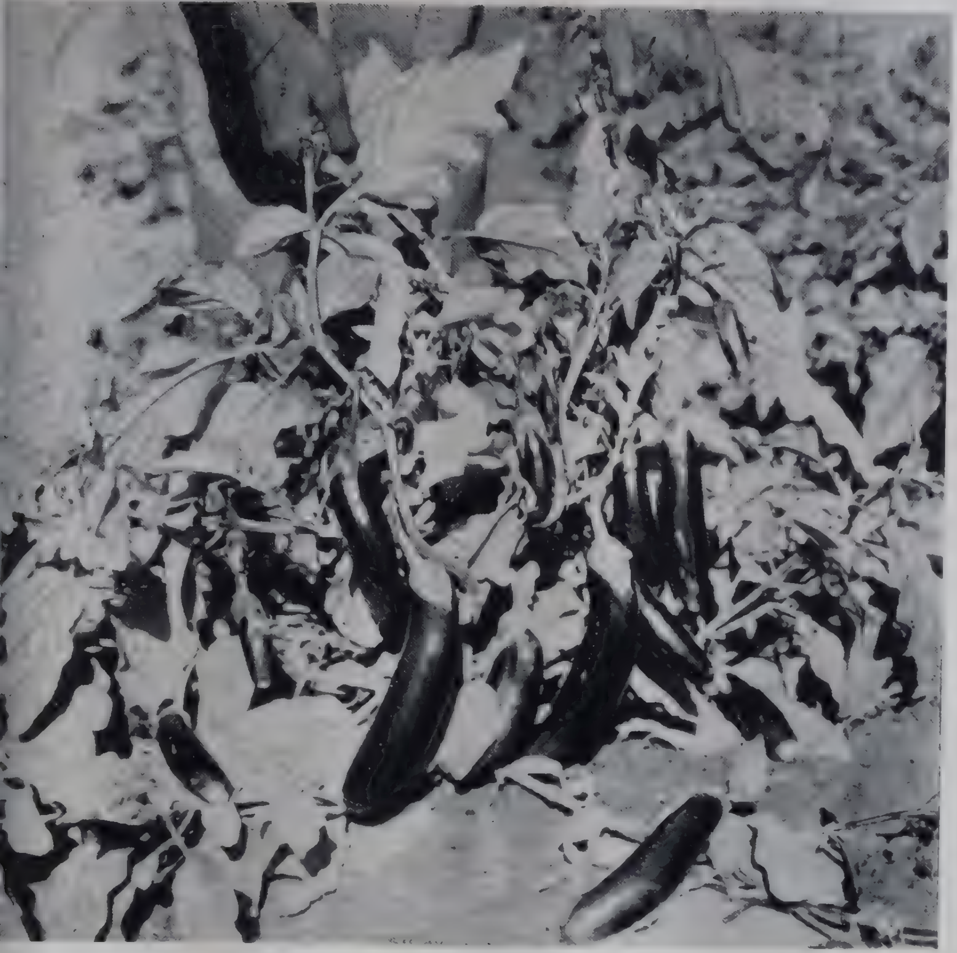


FIG. 1. A plant of Pusa Purple showing fruits. The branches have been raised to show profuse bearing of fruits

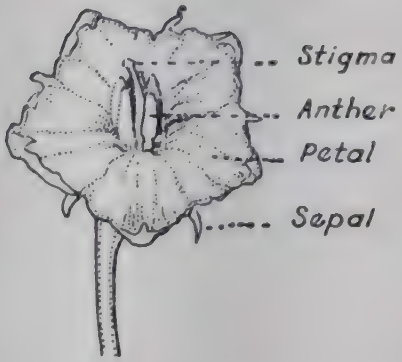
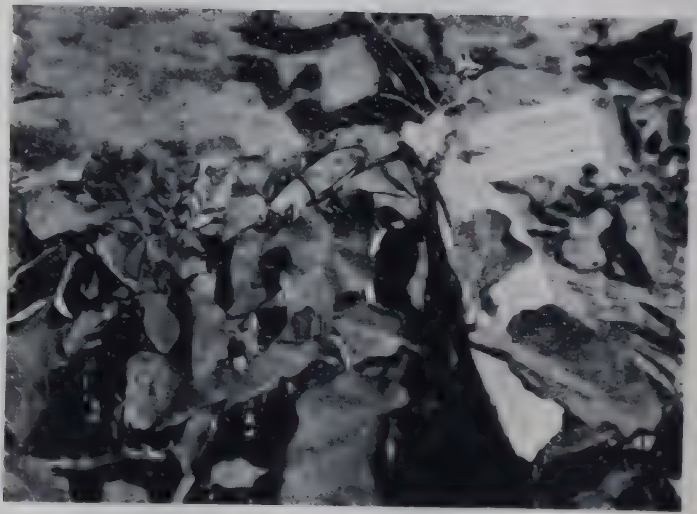


FIG. 2. A fully opened flower showing the various floral parts

FIG. 4. Bagging of the emasculated and pollinated flower



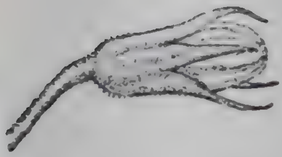


FIG. 3. A bud at the proper stage for emasculation

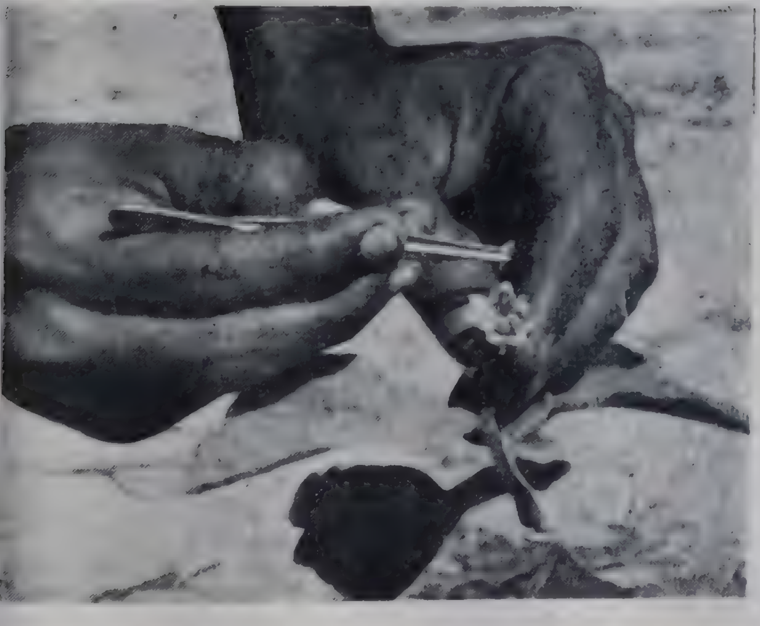


FIG. 5. Removal of anthers (emasculation)

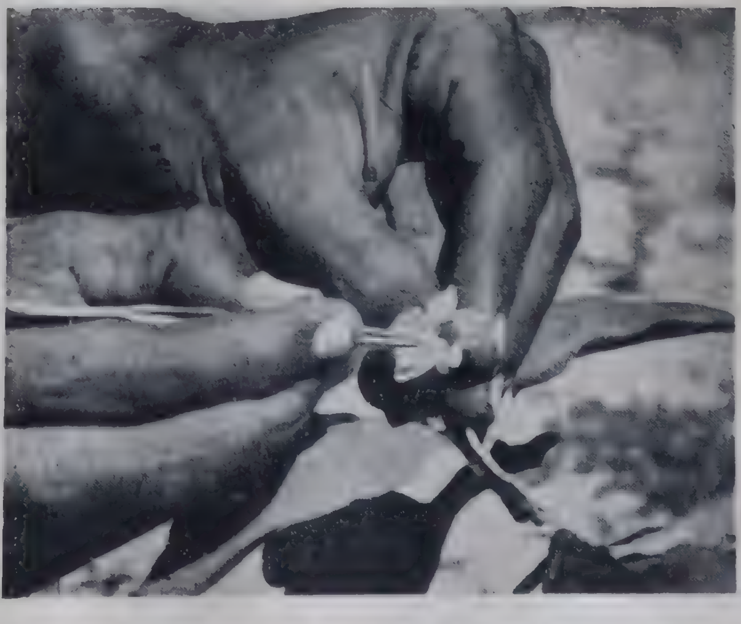


FIG. 6. Pollination ; the pollen is being applied to the stigmatic surface

Trials outside Delhi

To gain further information regarding the performance of this hybrid under different soils and climatic conditions, seeds were supplied to several Provincial Departments of Agriculture and to individual scientists and others residing in different parts of the country. The reports on its performance have been generally favourable, especially those from Almora, Banaras, Allahabad, Koilpatti (Madras), Calcutta, Pusa, Sabour and Lahore. At Almora a solitary plant which was kept through the winter yielded 300 fruits. From Allahabad the Superintendent of the Government Gardens wrote, 'the brinjals are of very superior quality and make very delicious vegetable. The variety is a heavy yielder and its cultivation should be extended as it would be a profitable variety. It gave a calculated yield of 504 maunds 9 seers per acre'. The Secretary, Royal Agri-Horticultural Society of India wrote from Calcutta, 'The brinjal seeds which you very kindly sent me last year have turned out to be an excellent type and I am anxious to let the members of the Society enjoy this type...........'

Nursery raising and planting in the field

The following directions apply to Delhi Province only, and in other areas the necessary adjustment for local conditions should be made. The seeds may be sown in the nursery from the beginning to the middle of July in finely prepared, raised or well-drained flat beds. About 100 seeds should be sown to each square foot of area, $\frac{1}{4}$ to $\frac{1}{2}$ inch deep. It is advantageous to keep the surface of the seed bed covered with a gunny-bag till the germination has commenced. Light hand watering should be done once a day. About 90 to 100 per cent germination may be expected in this way. The young seedlings should be protected from excessive rains. The seedlings will be ready for transplanting in about 20 to 30 days.

As the plants of this hybrid are of semi-erect habit, the seedlings may be planted $3\frac{1}{2}$ ft. apart each way in rich soils, the distance being reduced to $2\frac{1}{2}$ ft. or even less in the case of moderate or poor soils. The field should be irrigated soon after transplanting if there is no rain, or hand watering may be done once or twice a day, depending on the weather, till such time as flooding of the field is possible. After the seedlings have established the crop may be irrigated once a week till winter sets in. During winter months fortnightly irrigations will give optimum results.

In the nursery the seedlings are liable to be attacked by caterpillars and *Epilachna* beetles and in the field by caterpillars and shoot borers. To control ravages handpicking of the insects and removal of the shoots at the points where they have been bored should be done.

Crossing technique

The following hints on crossing may be found useful by those wishing to raise their own crossed seeds.

In the variety to be used as mother parent, the buds due to open the following morning have to be selected the previous evening for emasculation (removal of the stamens or male parts). Such buds usually have their corolla tube reaching the tip of the calyx lobes (Fig. 3). For emasculation the anthers are removed with the help of forceps by opening the corolla tube from one side (Fig. 5). The bud is then covered with a muslin bag measuring about 9 in.×5 in., the size of the bag depending on the size of the fruit of the mother parent (Fig. 4). Next morning the pollen (yellowish powder constituting the male element) from freshly opened flowers of the other parent is taken out by inserting the pointed ends of a pair of forceps into the anthers or pollen-sacs. The pollen is gently applied to the stigma of the emasculated flower (Fig. 6) and bagged again. Various parts of the brinjal flower are shown in Fig. 2. Experience has shown that it is not necessary to bag the flowers of the male parent as the pollen has to be taken out from inside the antherlobes. The bag should be kept on the developing fruit till it has grown sufficiently big because otherwise it is liable to be attacked by fruit borers. The seeds should be extracted soon after the detachment of the ripe fruit from the plant as it becomes difficult to separate the seeds from the dried pulp of the fruit.

Acknowledgment

We are thankful to the Directors of Agriculture, United Provinces, Bihar, Bombay, Bengal and Madras for kindly arranging the trials of 'Pusa Purple' at various stations in their respective provinces. We are also indebted

to the following for testing this hybrid brinjal: Mr. Boshi Sen (Almora), the late Dr V. K. Badami (Banaras), the late Dr H. Chaudhuri (Lahore), Dr K. D. Bagchee (Dehra Dun), Mr. S. Percy Lancaster (Cal cutta), Dr F. R. Bharucha (Bombay), Prof. P Parija (Cuttack) and officials of the Govern ment of India residing in New Delhi.

CONSERVATISM IN FOOD

NUTRITIONAL standards can be calculated with some precision, but appetite remains incalculable, a matter of individual habit. That explains the extreme conservatism of people all over the world in changing their diets. The British people during World War II disciplined themselves to preserve their political freedom at all costs. They, therefore, accepted with good grace, changes in their diets, but not at times without a good deal of scepticism. To effect an economy in shipping space, home-grown rye, oats and barley were added in the form of flour to the bread mixture. Dried skim milk was added for the sake of its nutritive value, and calcium in the form of chalk, to make good the deficiency of that mineral in the national diet. As in India, the British Food Ministry's advance announcement of this last expedient had an amusing sequel. Before the intention to add chalk was actually carried out, people started complaining that the bread tasted nasty !

It is obvious that people who feel that their personal convenience may be threatened by the new experiment in food, will naturally be reluctant to approve it. Their reluctance will be translated into cogent arguments against it. The arguments must be given full weight. Not all will be due to personal interest or prejudice. But in meeting such arguments, the paramount consideration must not be forgotton, that we are fighting a war for economic freedom. India struggling to preserve its economic entity needs every ounce of grain it can save. In the recent words of the Prime Minister: " The food problem is ultimately the totality of what happens in millions of homes. It is a small thing for each one of us to change his food habits slightly and eat substitutes for cereals to some extent. Every country has done so under stress of war and emergency. Are we so tied down to habit that we cannot do something that the good of the nation requires ? "—(*P.I.B.*)

TRENDS OF CATTLE POPULATION IN INDIA

By H. K. LALL

RECENTLY, increased attention has been paid to the cattle census figures, because it is essentially on the basis of these that the amount of milk produced in the country, the number of working animals, and their fodder requirement can be known, and targets set up to achieve the country's requirements in respect of cattle and cattle products. Excessive slaughter during the war gave an impetus to the general feeling that the country was being denuded of the cattle population, particularly the good cattle, thus resulting in an increase in the number of useless ones. To assess the degree of increase or decrease and also to determine, if possible, the factors affecting cattle population, the cattle population of various Indian provinces and States has been studied.

Natural trend in India

There are natural and artificial checks to the growth of population; natural checks are in the form of war, which usually means greater slaughter of animals for meat, famine, diseases and floods. The artificial checks are mechanized farming, which acts by elimination of bullocks, castration, and artificial insemination. The latter checks the increase in population by eliminating indiscriminate breeding. In India, so far no artificial checks have come into force, except, castration of scrub bulls, the number of which has been relatively small, with the result that indiscriminate breeding has been going on, though little less extensively. Artificial insemination and mechanized farming have hardly started and thus the trends of population in this country can be studied under almost natural conditions.

India and other countries

A comparison has also been made of the cattle population in India, with those of Australia, Denmark, the U.S.S.R., Canada, Netherlands, New Zealand, and the U.S.A. having systems of animal husbandry and dairying different from that prevailing in India.

It has been observed that population has increased since 1920, in various countries except in the U.S.S.R., and in India. The population in India steadily increased from 1920 and reached its peak in 1935 which was followed by a decline noticeable in the 1940 and 1945 censuses. In 1945 it went down to the 1930 level, but the rate of decline was the same as in 1940 and 1935. The population has considerably increased in the U.S.A. while it has increased slightly and steadily in the U.K., Denmark, Netherlands, New Zealand, Australia, in spite of the War and wartime shortages. The U.S.S.R. has shown a decline all along since 1920, except for a small rise in 1935-40. In case of the U.S.S.R. the great reduction in 1925 was the result of mass slaughter carried out by the farmers for resisting State control and collectivization of farming. There was some recovery in 1935, but then again the number possibly went down as a result of mechanization. The population in New Zealand, Australia, Denmark, and Netherlands, has increased because these are the countries, whose prosperity mainly depends on the export of livestock products. In the U. K., efforts have always been directed towards self-sufficiency; as fresh milk cannot be easily imported, people sought to increase the number of dairy cattle.

Cows and buffaloes

Since the buffalo in this country competes with the cow for food because of its milk producing qualities, and is likely to effect the cow population, figures for the buffaloes and cows in different provinces and States, for which census figures were available, were analyzed separately from 1920-45, i.e. for quarter of a century.

Cows: The analysis went to show that there was an increase in the cow population in Madras, Punjab, the Central Provinces and Berar, the N.W.F.P. and Coorg, in 1945 as compared to

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1940 and a decrease in Bombay, Sind, Bengal, the United Provinces, Orissa, Assam, Bihar and Hyderabad, the only State for which complete data were available. The population in the provinces did not follow the same trend in the quinquennial years. In all provinces, except for Bengal, the Central Provinces and Berar, the N.W.F.P. and Coorg, the peak was reached in 1935. Significant increase from 1920 level was attained only in the case of the Central Provinces and Berar where the maximum peak was reached in 1930, five years earlier than in the other provinces mentioned above. In Bengal after 1925, there has been a gradual but a constant decline; in the N.W.F.P. the population showing an obvious decline from 1920 onwards, exhibited a sudden spurt in 1940, which was maintained in 1945. The degree of fluctuation was much more in the case of Ajmer-Merwara and Delhi as compared to other provinces, thus showing that the fluctuations in population were more visible in smaller areas than in bigger areas, where perhaps a deficit in one part was covered by an increase in another.

Buffaloes: There has been a general increase in the number of buffaloes in all the provinces, except for some decline noted in Madras, Hyderabad, Ajmer-Merwara, and Delhi in 1940. In Bengal there was a slight decline from 1935 onwards, while in the Central Provinces there was a drop in 1935 and 1940. In 1945, there was a decline in Bombay and Sind, the United Provinces, Assam, Coorg, Bihar and Orissa, while the decline in 1940 in Delhi, Ajmer-Merwara, Madras and Central Provinces was made up by the increase in 1945. The Punjab has shown steady increase all along except for a slight decrease in 1945 as compared to 1940, but there has been an increase of 5·17 crores (18 per cent) over the 1920 population. This has more than offset the slight decrease in the cow population. This general increase in the buffalo population is in conformation with the belief that the buffalo has begun to replace the cow.

The analysis of figures of bullocks, youngstock, cows in milk and useless cattle indicates that there has been a general increase in the number of milking cattle except in Assam, Bombay, Coorg and Bengal. The number of young stock has increased except in Assam, Bombay, Coorg, Madras and Bengal. This decrease in the latter provinces is bound to reflect on the total adult population in the next census, because the adult population essentially depends on the number of youngstock that are born and survive. The number of working animals has decreased in Madras, Bombay, the Central Provinces and Berar and Coorg and Ajmer-Merwara, and has increased in Assam, Delhi, the N.W.F.P., the Punjab, Sind and the United Provinces. There is an insignificant increase in Bengal, while no figures are available for Bihar and Orissa.

Factors affecting cattle population

War influences: The excessive slaughter during the war has been ascribed to be the cause for reduction in the number of cattle. It has, however, been observed that the number of animals slaughtered in city slaughter-houses during the war years did not show any abnormal increase, though there was considerable increase in the number in Army abattoirs; but this number formed an insignificant percentage of the total population and could hardly be considered to have any material effect on the general strength of the population. The population in fact increased in the provinces where no restrictions on slaughter were imposed. Nevertheless the heavy drain on cattle on account of slaughter in the provinces of Bihar, Bengal and Orissa, where large number of troops were stationed, and the export from the United Provinces to the Eastern Provinces cannot be denied. The shortage was also felt because of the ban on the export of cattle from the Punjab, which in peace time supplied large number of cattle to these provinces. The rise in the cost of fodder and concentrates during the war and greater strain on the bullock due to lack of mechanical transport had an adverse affect on the stamina of the livestock in general. No doubt, this effect was counteracted to some extent by the rise of prices of livestock and milk. The effect of war therefore cannot be determined by merely taking the numbers into account; as a matter of fact the decline had already set in in 1935, before the war could have its effect felt on the cattle population of the country.

Diseases: The study of the mortality figures from the year 1930 to 1940, did not indicate any correlation between the growth of cattle population and mortality; for instance, Bengal, Orissa and Bihar showed a decrease in population in spite of low mortality rate, while there was an increase in the Central Provinces and Berar, having a higher mortality rate. This was very likely on account of the very inefficient system of reporting diseases in the country.

Fodder and grazing: A comparison of fodder and grazing available in the different provinces with the rate of increase or decrease in population in the present state of information does not help to establish any correlation between the two. It is however well known that area under fodder and grazing has not increased in proportion to the increase in population. In other words there is a state of over-population of cattle in spite of the recent reductions.

The population of cows in the canal colonies in the Punjab decreased while that of buffaloes increased because the enhanced prosperity on account of introduction of cash crops enabled people to consume more milk and *ghee*. Keeping this fact in view a comparative study was undertaken on the growth of cattle population and the increase in areas under various cash crops such as sugarcane, cotton, jute, and tobacco, in provinces where these are of importance, but no direct effect of the increase in area under cash crops on the population could be established. The fluctuations in the prices of hides and the number exported did not seem to have affected the growth of population in any appreciable manner.

Rainfall: Rainfall figures for the last 25 years for each province do not contribute towards establishing any relationship between the rainfall in a province and the growth of its cattle population, though it is well known that drought years are bad for the cattle population due to lack of grazing. In order to see the effects of rainfall as well as of the increase in area under cash crops on cattle population, a study seems necessary in small areas where their effects are likely to be more pronounced.

Availability of bulls: The number of bulls in the Punjab, and the United Provinces was small as compared to that in Bengal and Assam, which would mean greater fertility and of course uncontrolled breeding in the latter provinces. But in spite of this the population has been on the decline in Bengal since 1920. This perhaps could be explained by the fact that uncontrolled breeding there, combined with food shortage and malnutrition over a number of years, had an adverse effect on the breeding capacity of the cattle.

Famine and floods: These would affect the population in the area of occurrence. The Hissar famine of 1939 reduced the population of the district by one-half; possibly the reduction of cattle population in the Punjab by four lakhs in 1940 was due to this. No details of mortality due to Bengal famine are available, but the resulting malnutrition caused by it, is likely to have lasting effect, which may be more visible in later years.

Human population: Human population has increased and cattle population has decreased. As most of the cultivable area has to be devoted to food crops there is a reduction in the area used for grazing and fodder. Only when plenty of undeveloped land is available can the cattle population increase in proportion to the increase in human population, but when sufficient land is not available for a large population, the human population has to depend on a smaller number of efficient cattle rather than a large number of inefficient ones, and of course the systems of feeding have to be altered.

Export: It is a well-recognized fact that the export of cattle gives impetus to cattle breeding and that is why the south-eastern Punjab and Delhi, which export cows to Orissa and Bihar and buffaloes to Bombay, have a well-developed cattle industry. The exact data of inter-provincial export from time to time is not available and therefore its effect on the decrease or increase in general population cannot be gauged. The export of cattle outside the country is small and therefore its effect on cattle are primarily observed in the breeding tracts from where the animals are supplied.

Milk prices: The rise in the price of the milk during the war counteracted to some extent the depressing effect of the high prices of fodder and concentrates; not enough data, however, is available to establish the effect of variation in milk prices on the number of cattle.

Conclusion

It may be stated that in the Indian provinces, cow population in 1945 was less by 6 lakhs and 36 lakhs as compared to the 1920 and 1940 figures respectively. The 1945 buffalo population increased by 18 per cent as compared

1940 and a decrease in Bombay, Sind, Bengal, the United Provinces, Orissa, Assam, Bihar and Hyderabad, the only State for which complete data were available. The population in the provinces did not follow the same trend in the quinquennial years. In all provinces, except for Bengal, the Central Provinces and Berar, the N.W.F.P. and Coorg, the peak was reached in 1935. Significant increase from 1920 level was attained only in the case of the Central Provinces and Berar where the maximum peak was reached in 1930, five years earlier than in the other provinces mentioned above. In Bengal after 1925, there has been a gradual but a constant decline; in the N.W.F.P. the population showing an obvious decline from 1920 onwards, exhibited a sudden spurt in 1940, which was maintained in 1945. The degree of fluctuation was much more in the case of Ajmer-Merwara and Delhi as compared to other provinces, thus showing that the fluctuations in population were more visible in smaller areas than in bigger areas, where perhaps a deficit in one part was covered by an increase in another.

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Diseases : The study of the mortality figures from the year 1930 to 1940, did not indicate any correlation between the growth of cattle population and mortality; for instance, Bengal, Orissa and Bihar showed a decrease in population in spite of low mortality rate, while there was an increase in the Central Provinces and Berar, having a higher mortality rate. This was very likely on account of the very inefficient system of reporting diseases in the country.

Fodder and grazing : A comparison of fodder and grazing available in the different provinces with the rate of increase or decrease in population in the present state of information does not help to establish any correlation between the two. It is however well known that area under fodder and grazing has not increased in proportion to the increase in population. In other words there is a state of over-population of cattle in spite of the recent reductions.

The population of cows in the canal colonies in the Punjab decreased while that of buffaloes increased because the enhanced prosperity on account of introduction of cash crops enabled people to consume more milk and *ghee*. Keeping this fact in view a comparative study was undertaken on the growth of cattle population and the increase in areas under various cash crops such as sugarcane, cotton, jute, and tobacco, in provinces where these are of importance, but no direct effect of the increase in area under cash crops on the population could be established. The fluctuations in the prices of hides and the number exported did not seem to have affected the growth of population in any appreciable manner.

Rainfall : Rainfall figures for the last 25 years for each province do not contribute towards establishing any relationship between the rainfall in a province and the growth of its cattle population, though it is well known that drought years are bad for the cattle population due to lack of grazing. In order to see the effects of rainfall as well as of the increase in area under cash crops on cattle population, a study seems necessary in small areas where their effects are likely to be more pronounced.

Availability of bulls : The number of bulls in the Punjab, and the United Provinces was small as compared to that in Bengal and Assam, which would mean greater fertility and of course uncontrolled breeding in the latter provinces. But in spite of this the population has been on the decline in Bengal since 1920. This perhaps could be explained by the fact that uncontrolled breeding there, combined with food shortage and malnutrition over a number of years, had an adverse effect on the breeding capacity of the cattle.

Famine and floods : These would affect the population in the area of occurrence. The Hissar famine of 1939 reduced the population of the district by one-half; possibly the reduction of cattle population in the Punjab by four lakhs in 1940 was due to this. No details of mortality due to Bengal famine are available, but the resulting malnutrition caused by it, is likely to have lasting effect, which may be more visible in later years.

Human population : Human population has increased and cattle population has decreased. As most of the cultivable area has to be devoted to food crops there is a reduction in the area used for grazing and fodder. Only when plenty of undeveloped land is available can the cattle population increase in proportion to the increase in human population, but when sufficient land is not available for a large population, the human population has to depend on a smaller number of efficient cattle rather than a large number of inefficient ones, and of course the systems of feeding have to be altered.

Export : It is a well-recognized fact that the export of cattle gives impetus to cattle breeding and that is why the south-eastern Punjab and Delhi, which export cows to Orissa and Bihar and buffaloes to Bombay, have a well-developed cattle industry. The exact data of inter-provincial export from time to time is not available and therefore its effect on the decrease or increase in general population cannot be gauged. The export of cattle outside the country is small and therefore its effect on cattle are primarily observed in the breeding tracts from where the animals are supplied.

Milk prices : The rise in the price of the milk during the war counteracted to some extent the depressing effect of the high prices of fodder and concentrates; not enough data, however, is available to establish the effect of variation in milk prices on the number of cattle.

Conclusion

It may be stated that in the Indian provinces, cow population in 1945 was less by 6 lakhs and 36 lakhs as compared to the 1920 and 1940 figures respectively. The 1945 buffalo population increased by 18 per cent as compared to that in 1920, though it was slightly less in comparison to the figure in 1940. The cow and buffalo population went on increasing up to 1935, after which a decline set in, in the case of cows, though the buffalo population maintained, more or less, steady increase. Apparently, this goes to show that the conditions after 1935 were perhaps more favourable for the existence of the buffalo than for the cow. This was perhaps due to the fact that all the area available in the country began to be utilized for growing food crops for the increase human population. The result was a decrease in the area for grazing and fodder production. This, as one would expect, affect the cow more than the buffalo which, as is well known, gets preferential treatment on account of its higher productivity.

HORMONE SPRAYS INCREASE PEAR HARVEST

RECORDS kept by the New South Wales Department of Agriculture, Australia, concerning numbers and percentages of fruits dropped from trees before harvesting indicate that spraying with the hormone preparation 2 : 4 D, minimizes pre-harvest drop in William pears.

Following trials in the previous year, sprays containing 2 : 4 D at the rate of seven parts per million were applied to plots of William pear trees from late November, 1949, (the early part of the Australian summer), at intervals until a few weeks before the harvest period.

Records of the numbers and percentages of fruits dropped from the trees before harvesting confirmed that 2 : 4 D was highly effective in minimizing pre-harvest drop in pears of this variety.

In one instance, it was found that only one spraying of 2 : 4 D applied in November kept fruit drop in control. Further tests with single spraying will be made next season.—*Australian Agricultural Newsletter*, No. AGN/249.

BIRD FRIENDS AND FOES OF THE CULTIVATOR

By SALIM ALI

NOT so very long ago the agriculturists of Hungary, having branded the sparrow as an enemy of their crops, doomed it to destruction. Within five years the country was so overrun by insect pests that the sparrow had to be reintroduced. It proved the country's salvation by making short work of the devastating hordes.

A succession of alarmingly poor harvests in France caused the Minister of Agriculture, in 1861, to appoint a scientific commission to investigate the causes. It reported that the deficiency was due to the wholesale slaughter of birds, in the absence of which insect pests had multiplied unchecked.

The staunchest allies

These are just two examples out of many, and must serve as the writing on the wall to all who would have the welfare of the Indian cultivator and the agricultural prosperity of this country at heart. Owing to our innate tardiness in the adoption of progressive scientific techniques, we in India are today perhaps more completely dependent upon the good offices of friendly birds than in many of the more advanced countries. Birds are our staunchest allies here in the ceaseless warfare against crop pests, and it is indeed our misfortune that for want of proper enlightenment we do not realize this fact sufficiently, nor appreciate the magnitude of their beneficent services. Among the birds that normally visit or live about his fields, the cultivator has some very useful friends as he also has destructive enemies. He does not usually know to discriminate between them, and he quite naturally feels he cannot afford to take chances. Therefore he looks upon every bird visitor to his fields as an unwelcome intruder and does his best to scare it away if no more drastic remedy is at hand. And it is not the poor unlettered cultivator alone who suffers from this mentality. The ignorance displayed by people who should know better—even those who have had the advantage of a proper agricultural training—is often equally deplorable.

SALIM ALI is a well known authority on Indian birds and has long been connected with the Bombay Natural History Society.

The fact is that in India the powers that be have never viewed the question of the economic importance of birds with the sympathy or seriousness it deserves. Great strides have been made within recent years in many European countries and in the U.S.A. in research to determine the economic status of birds in general, as well as their value to agriculture, forestry, horticulture and other branches of human industry. Permanent organizations are set up and maintained at considerable State expense for conducting research, both in the field and laboratory, on the food and life-histories of native birds. Very impressive and far-reaching results have been obtained, and in a number of cases the benefits accruing to the agriculturist from a proper scientific control of birds based on such data have been clearly demonstrated by the saving of large sums of private and public money and by substantial additions to the national income.

Need for economic ornithology

It took a long time before economic entomology came into its own in this country. Its achievements and benefactions to agriculture during recent years do not need to be stressed here. The biological control of insect pests is now an accepted technique. Economic ornithology is nowhere in the picture as yet, but it is a subject that should not escape the planners of our destiny in the greater and more prosperous India to be; and the sooner a beginning can be made, the better for the cultivator.

Actually the work that has so far been accomplished in India on the status of birds in our agricultural economy is microscopic and negligible when viewed in the perspective of the vastness of the country, the richness of its bird-life, and the predominating position that agriculture occupies in its economic structure. But even the little that was done at Pusa some 30 years ago, and at Lyallpur more recently, on the food of certain birds in cultivated tracts—though admittedly piecemeal and haphazard since it fails to take count of the *complete* life-cycles of the birds—should have sufficed to convince the most sceptical well-wisher of the tremendous scope and importance of the subject.

Before it can be decided whether a bird is the cultivator's friend or foe—in other words, whether the bird is beneficial to agriculture or harmful, or neutral—it is essential that we first make a thorough study of its food and feeding habits during its entire life-cycle and not merely during one phase of it (e.g. as adult) or during a particular period when it happens to be unusually plentiful, or when its activities jump into prominence (e.g. as when some particular crop is ripening). Take a common example. A normal brood of the House Sparrow consists of three or four young. They are born helpless, and it is usually something like 12 days before they are grown enough to leave the nest and more or less to feed for themselves. During the whole of the nestling period they have to be fed assiduously by the parents. Young birds have voracious appetites: during the first few days of their life some species consume more than their own weight of food in 24 hours. The food of nestling sparrows consists of moths, caterpillars and other soft-bodied insects. Many of these are notoriously destructive crop pests, and some of the caterpillars may, in turn, devour as much as twice their own weight in leaves per day. One pair of House Sparrows have been observed to bring food to their nest-young between 220 and 260 times per day. Many of the beakfuls held not one but several insects at a time. Multiply this by 12 and you have some idea of the beneficial destruction caused by a single pair of sparrows during this short period, and particularly if the phenomenal prolificness of the insects is also taken into account.

Now, after subsisting entirely on insects so far, our brood of sparrows launches out into the world. Thereafter they betake themselves increasingly to the normal diet of their parents—predominantly grain and seeds of various kinds. As long as this food is gleaned from threshing floors or stubble fields, where it lies more or less as waste material, no great harm is done. But at certain seasons House Sparrows band themselves into enormous flocks and raid ripening *bajri* and other crops doing considerable damage. In addition to this, sparrows are at all times partial to flower and fruit buds and often destroy these on an extensive scale. They likewise make a nuisance of themselves in the vegetable plot. Now, are we to classify the House Sparrow as friend or foe? Are we to take steps to encourage the sparrow to increase and multiply, or are we to keep a strict check up on its numbers, or even exterminate it? This is where the difficulty comes in. But let us be reminded of the story at the commencement of this article; let the sparrow have the benefit of the doubt until such time as we have more precise quantitative and qualitative data concerning its activities.

This, in short, is the unsatisfactory position today. We do not really know for certain who our friends are and who our foes! In an empirical sort of way of course we can roughly gauge which among our birds are beneficial at given periods and in particular areas, and which are harmful. But that is not good enough. We know far too little about the all round status of the various species to justify launching any wholesale measures either for or against them, especially measures of a drastic character.

This then is the function of economic ornithology research: to study complete life-histories of birds in relation to human interests in an attempt to strike an accurate balance sheet of their activities. We have the working models of more advanced countries to guide us. The scheme may involve a considerable outlay and expenditure of public funds. But scientific research should not be judged purely in terms of financial gain.

Determining bird friends and foes

From the fragmentary information that is available at the moment, I would suggest the following alignment of the cultivator's friends and foes, selecting only a few each of the commonest species, and only such whose status appears to me to be more or less beyond doubt. Most of the insect-eating birds found in the neighbourhood of cultivation would probably fall in the category of the ryot's friends since the majority of the insects they devour in his fields are injurious. But there are many others on the borderline, such as the myna and the Rosy Pastor (Hindustani: *wyha*), beneficial at one season or in one phase of their life-cycle, harmful at another—whose status, like the House Sparrow's, can only be determined by a more critical investigation.

Friends	*Foes*
Black Drongo or King-crow	Jungle crow
Indian Roller or Blue Jay	House crow
Owl	Parakeets

I keep this list purposely small, but it includes the birds that are most usually met with about cultivation everywhere on the Indian plains in variable numbers, and are often quite abundant locally. The beneficial status of the bird friends is tolerably certain, and in the case of the foes I feel that there is sufficient evidence to proceed against them, even drastically in areas where they are menace.

Most poeple should have no difficulty in identifying the birds on the above lists: The Black Drongo or King-crow (Hindustani: *kolsa*, *buchanga* or *kalkilichi*) is of the size of the *bulbul*, uniformly glossy jet black with a long deeply cleft or forked tail. It is met with commonly about cultivation perched rather upright on stakes and telegraph wires. From these look-out posts it darts to the ground now and again to snatch up an unwary insect whose movement has betrayed it. Or it launches into the air to chase a flying locust or moth which is deftly captured on the wing. The birds may also be seen riding on the backs of grazing cattle, swooping on the grasshoppers and other insects disturbed by the animals' progress through the grass.

The Roller or Blue Jay (Hindustani: *nilkant* or *sabzak*) is a prominent and well-known species on account of the brilliant blues in its plumage which flashes in the sun as the bird flies deliberately from one look-out post to another. It keeps vigil singly on telegraph poles and the like near cultivation, and pounces upon large crawling insects like locusts. These it sometimes carries back to a perch and batters to pulp before swallowing. Although protected by law, the Roller is largely persecuted for the sake of its resplendent feathers which have some local demand and also fetch high prices if smuggled out of the country.

All owls, and most of the diurnal birds of prey, hawks, etc. are highly beneficial to agriculture in that they destroy enormous numbers of destructive rodents like field rats and mice, and help to maintain a constant check on the increase of these prolific vermin. All these birds deserve to be encouraged and conserved and not destroyed at sight as is now often the case. Our two commonest owls are the Spotted Owlet and the Great Horned Owl. The Spotted Owlet (Hindustani: *khakusat* or *chogad*) is of the size of the myna, but squat and short-tailed, with a large round head and staring, inquisitive, yellow forwardly directed eyes. In colour it is greyish-brown, spotted with white. It hides in the hollows of ancient trees during daytime and comes out to hunt at evening dusk. But it may sometimes also be seen on the move, and even hunting, in broad daylight. Its food consists of grasshoppers, crickets and other insects as well as lizards and mice. The Great Horned Owl (Hindustani: *ghughu*) is a large yellowish-brown bird of the size of the kite, with tufts of feathers standing out like horns from its head. It spends the daylight hours on ledges and recesses of earth, banks and ravines, or in large leafy trees, feeding at night chiefly on field rats, of which it takes a heavy and regular toll.

The two crows (Hindustani: *kawwa*) need no introduction. The jungle crow is the larger, and uniformly glistening jet black. In forest tracts and rural areas it more or less replaces the House crow (with grey neck) which is found about human habitations. Both species are destructive to *jowar*, *bajra* and other cereal crops, and barring a certain amount of scavenging that they do in towns, they possess no compensating virtues that could be called indispensable.

Parakeets (Hindustani: *tota*) of which there are several species in India—the commonest two being the Rose-ringed and the Blossom-headed—are birds of chiefly green plumage. They go about in noisy flocks, often very large ones, and are undoubtedly amongst the most destructive avian pests in India to cereal crops and fruit of all kinds. They seem to have no redeeming virtues whatsoever from the cultivator's or any other economic point of view, and their numbers deserve to be kept under the strictest check.

HYBRID CORN FOR INDIA

By BOSHI SEN

NOWADAYS it is possible to make plants to order, and hybrid corn is one of these new products. In 1947-48, a little over $7\frac{3}{4}$ million acres were under cultivation of corn (maize) in India. Our estimated total yield was a little over two million tons, 20 per cent short of the demand, and over four lakh tons had to be imported from abroad. Our average yield in 1947 was 8 maunds per acre, which is $1\frac{1}{2}$ *maunds lower* than the average yield per acre obtained during 1936-40. In the United States of America, during the corresponding period, the average yield per acre was *raised* from 16 maunds (1930-34) to 25·3 maunds in 1946. This increase was achieved by the use of hybrid corn seeds. In 1933, hybrid corn seeds were sown in only one acre out of a thousand, but by 1945, 675 acres out of a thousand were planted with hybrid corn. In that year, the increase of yield of corn in the United States of America was over 17 million tons. Translated into increased income to the farmers, this meant 700 million dollars.

Hybrid corn—a modern miracle

How was this miracle achieved ? By a long and strenuous programme of research work, carried out at a cost of nearly five million dollars to the U.S. Department of Agriculture. The old method of crop improvement was to select plants which showed desirable characteristics, and reselect from their progenies, and so on, until improved varieties were stabilized. Revolutionary changes in plant breeding work, however, have been brought about during recent decades as a result of the application of certain fundamental discoveries made about the middle of the 19th century by the Austrian monk, Gregor Mendel. Briefly stated, the principal concepts advanced in the Mendelian theory are that (a) the characteristics transmitted by the parents to the offspring, in both plants and animals, are determined by the unit factors, called genes, (b) the gene complements in the first generation of offspring from the same parents are similar, but (c) from the second generation onwards the genes segregate out in different combinations and patterns. The correctness of this theory has been amply verified by innumerable genetical experiments, and hybrid corn is one of the outstanding practical results.

Through work based on modern genetics, it has been possible to evolve new types of corn by combining several desirable characteristics and eliminating undesirable ones. For example, plants have been produced which have good roots and strong stalks, which are early or late as demanded by particular climates, which are resistant to diseases, and which have uniform vigour and high yield. But since in the progeny of hybrid corn plants, segregation takes place, hybrid corn for seed purposes must regularly be produced afresh. This is not only practicable, but an economically sound proposition, as proved by the results of the work in the U.S.A.

Almora trials

Different varieties of corn, like all other plants, have their own specific requirements of temperature, water and duration of the sunlight. Whether varieties of corn which have been evolved to suit the climatic conditions of different regions of the U.S.A. will do equally well in India, has yet to be determined by experimental trials in this country. Work along this line has been started at the Indian Agricultural Research Institute, New Delhi, and at the Vivekananda Laboratory, Almora. Small samples of the U.S.A. hybrid seeds, obtained through the courtesy of Dr Merle T. Jenkins, Corn Specialist, U. S. Department of Agriculture, were sown in June, 1948, in Almora, in replicated field plots, along with the local variety and one of the best U.P. varieties, T.41, seeds of which were obtained from Mr. M. A. A. Ansari, Economic Botanist, Kanpur. Seeds of the U.S. hybrid corn were also sent to several Experimental Farms in the United Provinces and to New Delhi for trials. Reports of these trials, indicate that as a result of the late monsoon in 1948 and excessive

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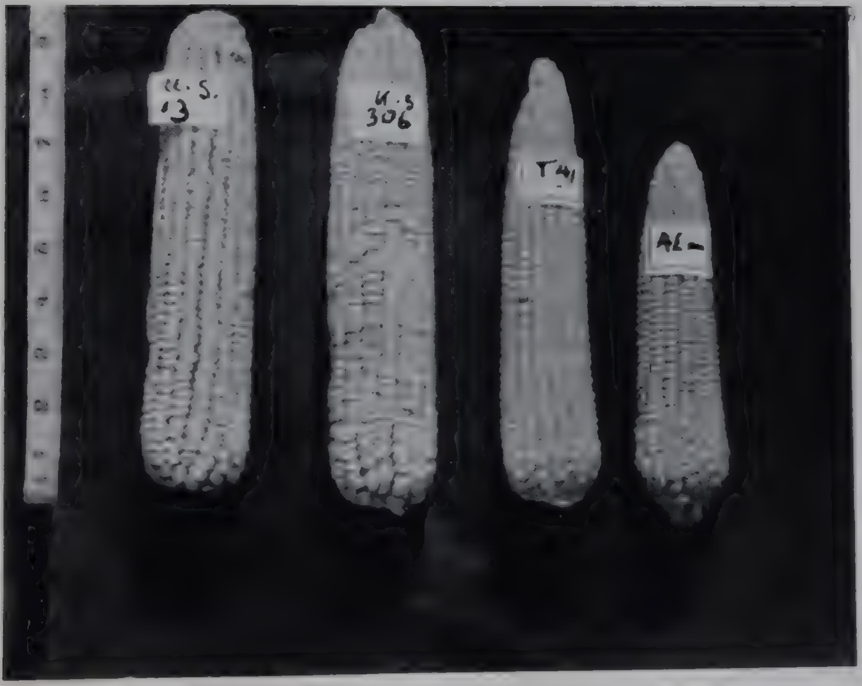

U.S.
13
U.S
306
T41
AL

Corn cobs grown in Almora. From Left to Right :
U.S. 13, Towa 306, U.P. T.41 and Almora Local

rain later on, there was either poor germination or the germinated plants became spoilt. The data obtained at Almora, on the other hand, were most encouraging. The observed yield per plant from the different varieties is given in Table I and the photographs of the cobs graphically illustrate the data given in the Table.

TABLE I

Yield per plant of different varieties of corn observed at Almora

Almora Local	T. 41	Min. 404	Towa 306	U.S. 13
0·77 oz.	3·91 oz.	3·01 oz.	6·73 oz.	9.09 oz.

It will be seen that compared to the Almora local, the yields of all the U.S. hybrids are unusually high, and compared to T.41, the yield of Min. 404 is lower, while that of Towa 306 is 72 per cent and of U.S. 13, 132 per cent higher.

Experimental trials with the U.S.A. and other hybrid corn should immediately be undertaken all over India, in view of our acute food shortage, and the necessity to conserve dollars for our industrial development. On the basis of Almora results, it would appear that by the use of hybrid corn seed, we can more than make up our 20 per cent deficit in corn, without increasing the acreage under corn cultivation.

The next question is, do we have to import our hybrid seeds, or is it possible for us to produce them in India ? The main work is to discover and produce desirable parent seeds of pure breed (inbred parents) which can be used for producing the desirable hybrids suited to particular growing regions. Once the seeds of suitable parents are obtained, the mating of different parents is a simple process, well within the competence of an intelligent cultivator. For corn, unlike wheat, for example, produces separate male and female flowers on the same plant. The tassel, or pollen bearing male flower, appears at the terminal end of the plant and the female flower, the cob with its silken strands, branches out from the stalk further down. Fertilization of the cob with pollen gathered from a selected tassel presents no very great difficulty.

Double cross hybrids

To obtain hybrid seeds on a commercial scale, double cross hybrids are used, since inbred parents produce weak plants and the quantity of seeds obtained from crossing inbred parents is generally small. For double crosses, four desirable parents, say A, B, C, and D, of pure breed, are selected. When the cob of A is fertilized by the pollen of B, a single cross, AB, is produced. Likewise when C and D are crossed, the single cross CD is produced. Both AB and CD seeds will produce uniform vigorous plants. Cobs of AB plants fertilized by the pollen of CD plants then give the double cross, AB×CD. Since in this case both parents have hybrid vigour, an increased quantity of seeds is obtained, thus making the production of hybrid seeds a good commercial proposition.

Technique of production

The technique of producing hybrid corn is very simple. The basic idea is to fertilize the cob of the pure breed female parent by the pollen from the tassel of a different pure breed male parent. This is normally done by dusting the silk of the cob with the pollen. When several varieties of corn are grown in a single experimental plot, the silk strands, before they emerge from the cob, must be protected by paper or cloth bags for a few days only, to exclude any contamination by unknown pollen (which may be floating in the surrounding air or carried by visiting insects). Bagging is unnecessary, however, if plots at least 300 yds. apart are available. Then only two varieties to be crossed are planted in adjacent rows in a single plot. As soon as the tassels emerge in the plants selected for the female parent, they are simply pulled out by hand, and the cobs are then automatically fertilized by the pollen from the tassels left intact on the male parent. The cobs of the female plants will produce hybrid seeds—single crosses, if inbred parents have been used, double crosses, when single crosses are used as parents. In single cross plots, the cobs of the male parent plants will give inbred seeds. In double cross plots, the seeds produced in the cobs of the male parent should not be used again for sowing, but should be utilized for consumption.

Increase yield of corn obtained by the use of hybrid seeds in the U.S.A. has more than repaid the extra cost of the seed production. A new industry valued at 70 million dollars a year, for producing hybrid corn seed, has grown up. In India, to begin with, production of hybrid corn seeds should be undertaken by our Government Farms. Later on, a few intelligent cultivators in every suitable corn-growing area can be taught how to produce hybrid corn on a small scale, to meet the local needs. This work might well be taken up by the *Gaon Panchayats.*

In the field work efficient help was rendered by Shri Bansilal Sah and Shri Udinath. The data were kindly analysed by Shri A. R. Roy, Statistician (A.H.) I.C.A.R., New Delhi. The expenses of this work were met from a grant from the Department of Agriculture, United Provinces, for my Scheme of Plant Introduction.

EXPLOITATION OF FISHERIES

FISHERIES, which can aid substantially to the food resources of the country, will receive special attention in Madras as a result of the steps now being undertaken to accelerate the fish production in the province. A special scheme has been drawn up in consultation with the experts of the Government of India whereby the internal production of fish in the province is expected to be increased by at least 50 per cent. Extension of the area of marine fishing is also envisaged in the scheme.

At present, the production of fresh water fish in the province is about 1,87,000 mds. This quantity can be substantially increased by better stocking of existing tanks and lakes with fry and fingerlings, and at a small expense. The scheme that has been drawn up proposes to give high priority to the collection, distribution and stocking of fry and fingerlings. Intensive stocking, preferably in small tanks and ponds, where they can be easily caught is proposed and all available water including about 30,000 tanks which the Provincial Government proposes to renovate for irrigation purposes under the Grow More Food scheme are to be put under fish culture.

In sea fishing, Madras has already made some progress as she produces about 60 per cent of the total sea fish caught in India. The quantity caught is, however, small as compared with the fishery potentialities of the Indian waters and the new scheme proposes special steps to extend sea fishing. Supply of country boats specially fitted for sea fishing, nets and yarn are proposed to be supplied in larger numbers. A small number of motor-boats will also be made and supplied to cooperative societies, especially on the West Coast for experimental fishing and demonstration. A small beginning is also to be made for fishing with modern powered-vessels.—*Food Bulletin*, August 1, 1949.

RESEARCH ON PULSES

PULSES play a vital role in Indian diet as they form the main source of proteins for the large vegetarian population in the country. India possesses a wealth of pulses such as *arhar*, *mung*, *chena*, *urad*, peas, horse-gram, etc. Since 1943 the Indian Council of Agricultural Research has been financing coordinated pulse research schemes in Madras, Bombay, West Bengal, the United Provinces, Bihar, Assam, Central Provinces, Orissa, Hyderabad, Mysore, Gwalior and Baroda with the object of producing high-yielding disease-resistant types possessing commercially desirable qualities. The value of some pulses in green manuring, rotation and mixed cropping was also taken up for investigation.

Madras: A scheme of research on pulses commenced in 1944 with the object of isolating high yielding strains resistant to disease and possessing trade characters such as bold size of grain, attractive colour, flavour and cooking quality. The pulses included are: tur, *urad*, horse-gram, *chena*, cowpea and *lablab*. The work is conducted at three centres in the province, viz. Coimbatore, Salem and Vizianagaram. The breeding work on pulses in Madras province from 1944-48 has resulted in the production of 46 promising selections in *arhar*, 8 in *mung*, 15 in *urad*, 120 in gram, 25 in *lablab*, 12 in cowpea and 48 in horse-gram which are under yield tests. At Salem four selections of *arhar* (35, 37, 56 and 59) which showed promise in the previous year have during 1947-48 given significantly higher yields than the control. The yields of gram per acre were 714, 786, 644 and 718 lb. respectively, while the control gave only 476 lb. Out of these, since culture No. 37 has been consistent in giving the highest yield, it has been sent out for trial at 21 centres in the districts under cultivators' conditions.

Under mixed cropping experiments a study of the economics of growing pulses alone or mixed with other crops such as cereals, groundnut, etc. were conducted. The results obtained over two consecutive seasons revealed that *arhar*, mixed with a spreading variety of groundnut, gave the maximum out-turn per acre.

United Provinces: Work on eight pulses, viz. *arhar*, *urad*, *mung*, soya-bean, moth, gram, lentil and pea has been in progress since April, 1943. Cooking tests on improved types of *arhar*, *urad* and gram were conducted in comparison with the local types. In *arhar* strain 17 W/2 produced the best *dal*, T66 ranked second, while 51 W/1 was third. In *urad* strain 12/5 was first for *dal*, while other two improved types 8B and NS 2/9 were only as good as the local. Of the gram selections, tested for cooking as well as parching, strain 87 proved the best and NP-25 and Banda were second and third respectively.

In the mixed cropping, *arhar* and broadcast *jowar* gave the highest out-turn during 1947-48 season. In rotation experiments, the results again indicated the beneficial effect of a preceding pulse crop. The highest yield of fodder *jowar* was obtained after an *arhar* crop preceded it.

Assam: High yielding strains of *arhar* have been produced of which mention may be made of R-3b with an yield of 912 lb. and R-7 which gave 658 lb. per acre as against the mean yield of 572 lb. for all the strains tested.

Bihar: Arhar varieties were classified into three types—early, medium and late according to their time of maturity. The late types were further divided into erect and spreading. Four selections in early, 9 in medium, 15 in late (spreading 8 and erect 7) types have been obtained with potentialities for high yield which will be tested. In peas 10 good strains suitable for general cultivation have been established.

Central Provinces and Berar: Improved strains of *tur* No. 31 and Hyderabad P.E. have given the highest yield of 507 lb. per acre which represents an increase of 48 per cent over the control E.B. 3. A strain of *mung* gave about 166 per cent more yield than the control variety. A strain of *urad* (No. 55) yielded 500 lb. per acre, i.e. 172 per cent more than the local variety. Strain No. 88 of moth yielded 272 lb. per acre which is 61 per cent more than its control. Wilt is a great menace to *tur* and causes heavy losses every year particularly in the wilt-infected areas of Berar. A strain No. 31 has been evolved which combines high yield with resistance to wilt; it gave 48 per cent increased out-turn per acre over control and the lowest infection of 2·3 per cent wilt attack.

East Punjab: The wilt disease causes serious damage to the gram crop in East Punjab which is estimated at over two crores of rupees annually. A scheme is being financed by the Council since 1943 to investigate the life-history and causes of gram wilt and devise simple measures for its control and discover varieties resistant to it. It is reported that experiments conducted for the fifth year in succession have failed to establish a pathogen as the cause of gram wilt as it occurs in the Punjab. Non-biological agencies such as unfavourable soil conditions, deficient soil moistures and high temperature at the time of sowing and towards the end of the gram season are considered by the workers to be the main causes of wilt in gram. (R.S.)

WATER REQUIREMENTS FOR CROPS

IN order to step up food production in the country, the Standing Advisory Committee for Research on Water Requirements of Crops has decided that research on water requirements of crops should at present be particularly concentrated on the optimum use of irrigation water so as to obtain the maximum yield of crop from a given quantity of water.

It has also been decided to frame standards for layout of trials, measurement of water, temperature, humidity etc., to enable results of experiments carried out at different stations to be compared.

In a resolution passed by the Committee, it has asked Provincial and State Governments to request their Chief Engineers and Directors of Agriculture to meet and formulate proposals for the problems on which they would like research to be carried out in connection with the optimum use of irrigation water. It has been suggested that they should select three or four farms for these experiments in their respective administrations representative of the conditions prevailing in the whole area. To ensure effective coordination for the carrying out of these experiments it has been stressed that provision of staff at each station should include a representative each of Departments dealing with irrigation, agriculture and meteorology. A special feature of the new studies will be the malarial aspect of water standing in irrigated fields and channels.—*Food Bulletin,* August 1, 1949.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Could you please give information on the causes of rust in wheat, and its remedy? (G. S.)

A. Rust is caused by the wind-borne spores of parasitic fungi.

Three forms of rust, black (*Puccinia graminis tritici*), yellow (*P. glumarum*) and orange or brown (*P. triticina*) are found in India. Black is found in all parts of the country, in hills as well as on the plains. Brown also is noted everywhere except perhaps in a small part of the Peninsular India. Yellow and brown rusts are common in the Punjab, while all the three are found in the United Provinces and Bihar. Black rust is, however, predominant in the plains of the United Provinces and Deccan. These rusts, particularly the black and yellow, cause considerable damage in the areas where they occur, their intensity depending upon the prevailing weather conditions. Though palliative measures like the eradication of alternate and collateral hosts of the disease, application of fungicides and cultural and cropping practices may be practiced, the main remedy lies in breeding varieties of wheat resistant to these rusts. But the problem is much complicated by what are called the physiological races in these three forms of rusts, each of which have distinctive infective potentialities different from the other. Nine races of black rust, eight of brown and ten of yellow have already been identified in India. But, India is fortunate to possess a highly resistant variety of indigenous wheat, the Kapli variety, which has been largely used as one of the breeding partners in most of the rust-resistant hybrids. In the schemes financed by the Indian Council of Agricultural Research since 1934 and worked in Simla, Bombay and in the Central Provinces, the main aim was to breed such strains of wheat as would be immune or resistant to these physiological races, especially to all the races of the three rusts put together. Already, a fair range of improved varieties resistant to one or the other rusts separately have been evolved for the wheat growing tracts and adopted by the cultivators. A coordinated All-India Scheme to tackle the problem in a comprehensive way is now under the consideration of the Government. (I.C.A.R.)

SALVATION THROUGH IRRIGATION

THE Indian Union tops the list of the nations of the world which have substantial irrigation systems. According to latest available estimates, the acreage under irrigation in India exceeds the combined total acreage irrigated in the U.S.A., U.S.S.R., Japan, Egypt and Italy—some of the leading countries in this field. These five countries between them occupy roughly ten times the total area of the Indian Union.

Despite the country's supreme position in this field, the amazing fact that has long stared Indian economists in the face is that, on the whole, the yield per acre in India is about the lowest in the world. What is the explanation of the phenomenon that a country which has the world's finest and largest irrigation system, groans under the weight of heavy imports of foodgrains from abroad year after year ?

Capricious nature

The explanation is simple enough. For every acre of cultivated land under food crops in the country receiving its water supply from irrigation canals or tube-wells, there are many acres which are unirrigated and have to depend for water supply upon the rains. The rainfall is very unevenly distributed. Then, the rains may arrive too late or too early. Having arrived, the rains may be too light or too heavy. Consequently, there may be partial or complete famine, or, if the monsoon is heavy, there may be floods. In either case, food crops suffer. Crippling imports to make up the deficiency between demand and supply thus becomes necessary.

The tragic regularity with which crops in India have in recent years suffered from one cause or another, either from drought or from a heavy downpour, is well known. Must the nation ever remain a mute witness to recurring havoc caused by famines and floods ?

Lasting solution

The only lasting solution of the country's troubles would appear to lie in the gradual reduction, and eventual elimination, to the largest extent possible, of the cultivator's direct dependence on rain and his being provided with an alternative source of water supply which has the minimum element of uncertainty in it, preferably round the whole year. In other words, the solution would appear to be to have extensive irrigation systems in those parts of the country which are at present poorly irrigated. Then only, with an adequate and steady flow of water assured to him, can the cultivator in India become an effective participant in the drive to produce more and ever more food.

Many foreign countries, faced with similar problems of controlling floods, forestalling famines, and increasing the acre-yield of their land, have found a solution through elaborate systems of controlling their rivers and regulating their waters with the help of large reservoirs and canals.

The reader in India is familiar with a number of multi-purpose river valley projects which various provinces and States have on hand. These are designed to control floods and provide large-scale additional irrigation, hydro-electric power for agriculture and industry, and facilities for fish culture, inland navigation, afforestation, soil conservation, etc.

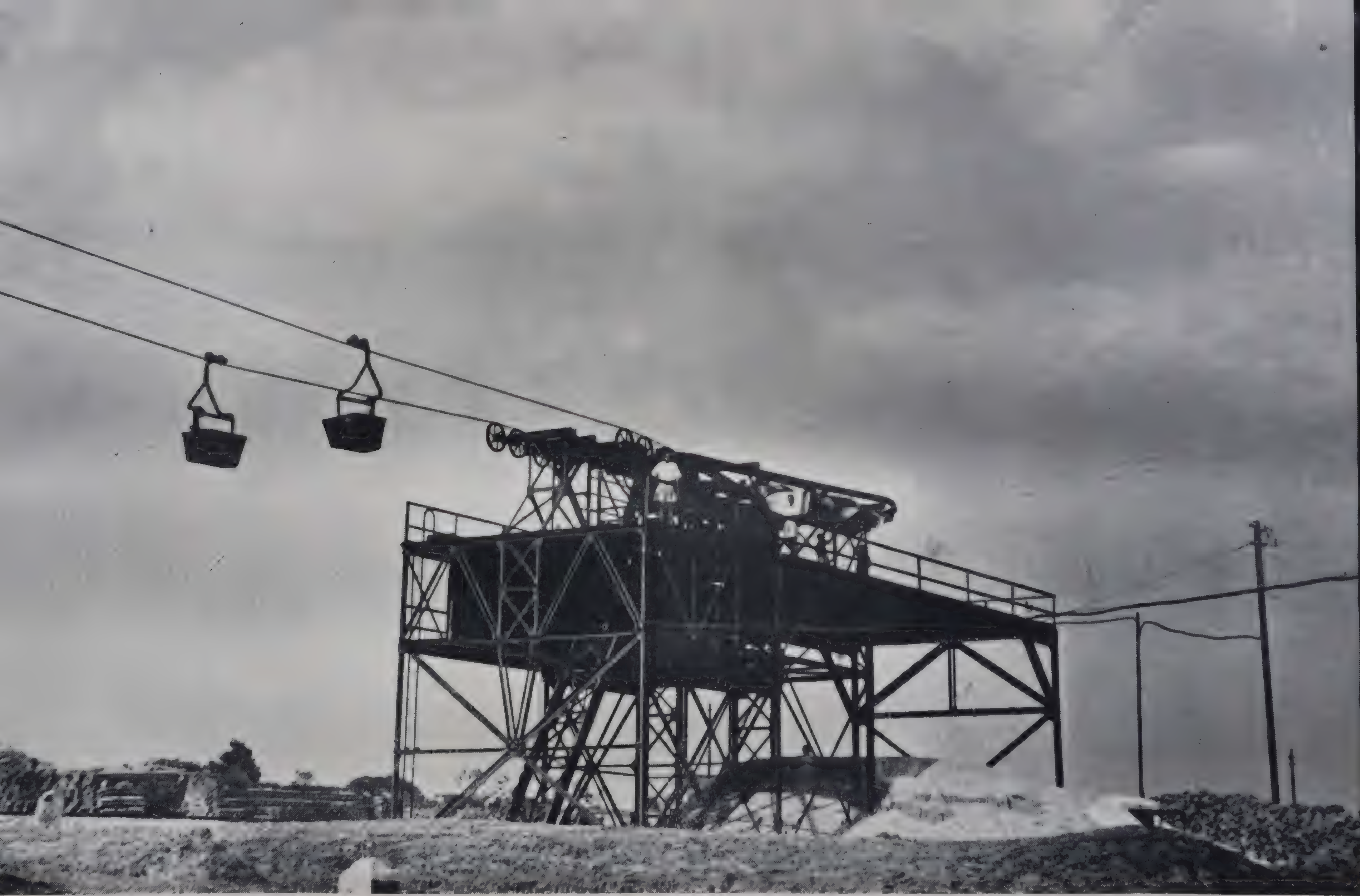
New projects

The Central Waterpower, Irrigation and Navigation Commission, which is India's national agency for the multi-purpose utilization of water resources, some time ago invited the Chief Engineers of provinces and States to furnish complete data regarding the projects they had under execution, investigation or contemplation. The object was to draw up a seven-year programme which would give top

PLATE 52 View from the top of the Parasnath Hill, showing some of the uncultivated land that will be irrigated by the Damodar Valley Scheme

PLATE 53

Damodar Valley: Survey party at work near the Konar Dam site.



Sand-stowing head in a Jharia Colliery. Sand is received at this end through a ropeway from the Damodar River-bed and blown into the mine-shafts and tunnels

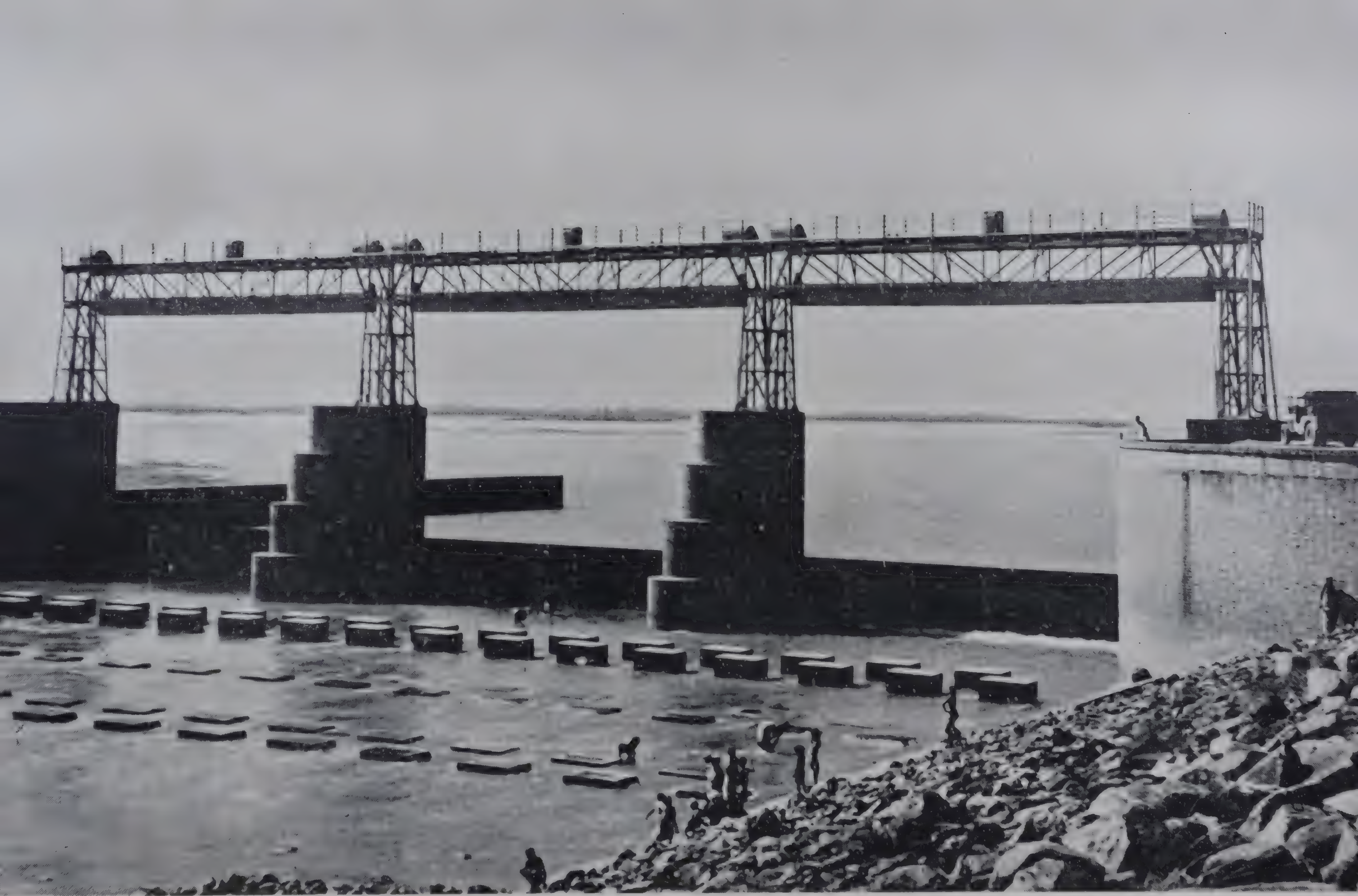


PLATE 55

The Anderson Weir on Damodar River in Burdwan District, West Bengal.

priority to projects promising the quickest yield in foodgrains.

According to information received, there are in all 160 projects under execution, investigation or contemplation. Many of these are purely irrigation or hydro-electric projects. Out of these 160, 46 are actually under construction, 53 have reached advanced stages of investigation, and in the case of the remaining 61 investigations have just begun. The total cost of all these would be in the neighbourhood of Rs. 1,280 crores.

When all these projects are fully developed, the country will boast of additional irrigation to the tune of over 25 million acres (approximately equivalent to the entire area under irrigation in the U.S.A. at present). The additional yield of foodgrains and hydro-electric power would be five to six million tons and about 10 million kilowatts respectively. The revenue from this additional food and power has been estimated at Rs. 135 crores per annum (on an investment of Rs. 1,280 crores).

Out of the 46 projects under construction, 17 are expected to cost less than Rs. 1 crore each, 16 between Rs. 1 and 5 crores each, and four between Rs. 5 and 10 crores. The average cost of these 37 works out roughly to less than Rs. 1·5 crores per project. The remaining nine are comparatively large projects and are expected to cost anything between Rs. 10 and 100 crores or more each. Among these, nine, covering some of the potentially richest parts in the east, west, north and south of the Indian Union, are the Damodar Project in West Bengal and Bihar; the Hirakud Project in Orissa; the Rihand Project in the United Provinces; the Bhakra and Nangal Projects in East Punjab; the Tungbhadra Project in Madras and Hyderabad; and the Mor Project in West Bengal.

Food production from 1950-51 onwards

What will these 46 projects achieve and how soon? Present calculations show that while the smaller ones may be completed in between two to three years, some of the bigger projects may take seven years or a little more, provided the supply of construction materials like cement and steel is forthcoming according to a schedule drawn up by the Ministry of Works, Mines and Power.

The estimated requirements of steel and cement are above one lakh tons and six lakh tons respectively per annum for seven years. Funds required would be approximately Rs. 50 crores per annum for this period.

Food production from some of the projects is expected to start coming in as early as 1950-51. From about 173,000 tons during that year, the additional food yield is likely to increase almost eightfold to about 1,380,000 tons by 1955-56. On completion, these projects will enrich India's granaries by an aggregate of some three million tons per annum—slightly more than imports of foodgrains from abroad during 1948-49.

Besides, nearly 1·85 million installed kilowatts of new hydro-electric energy would become available on completion, nearly doubling the present installed capacity of hydro-electric plants throughout the Indian Union.

Minor adjustments possible

As increased production of food is today the paramount need, it is likely that minor adjustments in the execution of even these 46 projects will be found necessary. For instance, work on portions of a project relating to power may be slowed down, and the available resources concentrated on its irrigation aspect. In addition, sponsoring administrations may be left to execute the smaller projects costing less than Rs. 5 crores without calling upon the Central Government for financial aid. In that event, the Centre will be left to exercise control only in respect of a small number of projects costing over Rs. 10 crores.

While it is too early to anticipate Government's decision, the probability is that, in any case, all the 46 projects under construction will be allowed to go forward. It is easy to imagine what the additional food and electricity produced through these would mean to the country's economy and its programme for industrialization.

True economy

During 1948-49, the Government of India had to spend Rs. 120 crores to import 2·8 million tons of foodgrains from overseas. According to present indications, the expenditure on imported foodgrains during 1949-50 may go up to Rs. 150 crores, and the quantity imported may be as much as four million tons.

A question that may well be asked is: Is India, with an accumulation of so many difficult problems to solve, in any position to spend Rs. 370 crores (estimated expenditure in seven years) on these 46 projects and perhaps further amounts if more projects, which are ready for execution, are taken in hand? A realistic answer to this question can only be provided by a counter-question: Is the country in any position to go on spending Rs. 150 crores or so *per year* on imported foodgrains, especially when substantial portions of this money have to be found in precious dollars?

There appears to be no alternative to river development projects on a large scale, if production of food is to overtake the growth of population and if cheap power is to be made available for agriculture and industry. This conclusion becomes irresistible when it is remembered that many of the river valley projects will not only give the country the two vital requisites of progress just mentioned, but also a number of other subsidiary, but in the long run no less important, advantages like fish culture, afforestation, soil conservation, internal navigation, provision of drinking water in parts of the country, recreation facilities, etc. (*P.I.B.*)

SARVODAYA PRADARSHNI AT JAIPUR

CHATTAR SINGH SIDHU

THE *Sarvodaya Pradarshni* arranged, in connection with the Fifty-fifth Session of the Indian National Congress at Gandhinagar (Jaipur), in the third week of December, 1948, was the first of its kind in free India. It was a grand show full of utility and educative value. The visitors, to whatever walks of life they belonged, were markedly impressed with what they saw.

It was comprised of the following sections:

1. Model village
2. Sanitation
3. Village culture
4. Village industry
5. *Khadi*
6. *Adi-vasee*
7. *Nai taleem*
8. Nature cure and ayurved
9. Women and children's home
10. *Gram-udyog bazar*
11. *Gosewa* and agriculture
12. Rajasthan court (art and culture of Rajasthan)
13. Bapu *mandap* or *Sarvodaya* literature

Agriculture and *Gosewa* Section with which the readers of *Indian Farming* are mostly interested, was the biggest Section spreading over five courts, each court measuring 100 ft.× 150 ft. This Section comprised of stalls which the various research and development sections of the Ministries of Agriculture, Food and Health, Government of India, and Agriculture and Veterinary Departments of Provincial Governments and States had put up in the spacious squares. Every stall had some material at least of definite interest for the visitors. A short account of some of the exhibits is given below.

CHATTAR SINGH SIDHU is Assistant Director of Agriculture, Jaipur State.

Tomatoes

The Indian Agricultural Research Institute, New Delhi, exhibited some superior varieties of tomatoes which they had developed by crossing with a wild strain from America. Two of these varieties T.S. 16 and T.S. 21, were said to be richer in vitamin contents and sweeter than the local ones and were less susceptible to frost.

Fuel gas plant

A small model of the Fuel Gas Plant exhibited by the Indian Agricultural Research Institute was very interesting. If this cuold be finalized into a practical proposition, it would be a boon for the village people and would go a long way in improving their ways of living.

Cattle dung mixed with water is placed in a drum where after decomposition it gives rise to a mixture of gases (hydrogen, carbon monoxide and methane) all inflammable, producing a non-luminous flame. These gases are collected and stored in another drum from which they are utilized for lighting and generating heat for cooking in houses. If the scheme works, one or two such plants in a village could meet the entire household requirements of light and fuel thus putting an end to an obstinate problem of burning dung. In this process the dung is also not wasted. The refuse left after gas formation is a thoroughly rotten manure which is said to contain 1·5 per cent nitrogen, 1·36 per cent P_2O and 0·7 per cent K_2O.

Food and nutrition

The demonstrators of the food and nutrition stall explained to the visitors the various groups of food materials rich in various classes of vitamins and the deformities and diseases prevalent in animals and human beings on account of insufficiency or want of such vitamins. This stall distributed free some literature published on human diets as recommended for different classes of workers, labourers, small families, mothers, children, etc. Two of these, one for agricultural labourers and the other for suckling mothers, are reproduced below for the interest of readers.

Cheap diet for labourer (agricultural)

Cereals	12 oz. (wheat, rice, maize, etc.)
Other cereals	4 oz. (*jowar*, *bajra*, etc.)
Pulses	2 oz. (red gram, lentil, *arhar*, etc.)
Roasted gram Sprouted gram	4 oz. (Mainly used as breakfast and afternoon snack)
Leafy vegetables	4 oz. (*lal sag*, and other *sags*. Also green *sag* consumed raw during winter season)
Other vegetables	6 oz. (brinjal, gourd, pumkin, lady's fingers, etc.; potato when comparatively cheap)
Fats and oils	1 oz. (generally mustard oil. But no objection to *til* and *mahua* oil, etc.)
Fruits	4 oz. (*kakri*, *kharbuja*, guava, *jamun*, mango, papaya, etc.
Butter milk	8 oz. (*lassi* from skimmed milk or *dahi*)
Jaggery	2 oz.

Note: The calory value of this diet comes to about 3,000.

Diet for suckling mothers

Cereals	7 ch.
Pulses	5½ ch.
Leafy vegetables	2 ch.
Other vegetables	3 ch.
Ghee or oil	1 ch.
Milk	10—12 ch.
Sugar or *gur*	1 ch.
Fruits and nuts	2 ch.
Eggs	1
Meat or fish	1 ch.
Condiments	For taste

Note: 1. Drink plentiful water.
2. Two *chhataks* of milk and one *chhatak* of fruit to be taken more by vegetarians instead of meat, egg and fish.

Wooden chakkies

Unpolished or brown rice, i. e. partially pounded rice, which has now been agreed by all scientists to be much more nutritious, delicious and richer in vitamin B_1 content than the polished rice, was also advertised. A stall of the Wardha Gram Udhyog exhibited wooden *chakkies* to produce brown rice of the desired quality. These were just like the ordinary stone *chakkies* with this difference that in these cases hard *shisham* wood replaced the stones. These afforded a practical solution for securing healthy and richer type of rice. Such *chakkies* are procurable from Wardha.

Fruit preservation

A small and compact stall of the Vegetable and Fruit Preservation Section attracted large crowds of visitors. Demonstration of the proceses of preparation of the preserves was the speciality of this stall. A small but useful booklet giving brief instructions for preparing the various squashes, juices, marmalades, *chutneys*, pickles, jams, and jellies, etc. was distributed at a nominal cost of one anna.

Land improvement

The stall of the Bombay Provincial Department of Agriculture was conspicuous for its original and valuable work on soil preservation, contour bunding (against erosion), dry farming and land improvement work in Bombay Province. The charts, graphs, and models exhibited were very instructive. Prospectus and Syllabus of the Soil Conservation Institute at Sholapur were distributed free. This Institution run by the Bombay Provincial Government is imparting training in land improvement to *bona fide* cultivators, Agricultural Assistants, Science or Agricultural Graduates and Agricultural Officers. The Syllabus includes a thorough study of soil erosion, land surveying, soil engineering, dry farming methods and practices, contour strip cropping technique, reclamation of waste lands and forestry and range management

The United Provinces Irrigation Department had taken sufficient pains to lay out skilfully a spacious and beautiful model of ridges, rivers, bunds, weir and head-workers, etc. to show in an interesting way how unruly and wasteful rivers can be tamed and diverted to useful and productive ends.

Gur

The Agricultural Department of the United Provinces exhibited various samples of *gur* and *shhakkar* (powdered *gur*) of very superior quality. The actual processes of cleaning and clarification of juice and of making *gur* of the requisite quality were demonstrated at the spot. *Gur* is a valuable food of the rural people. Being more nutritious and cheaper than white sugar, it has scope of entering into the dietary of the middle classes also, if production of superior quality *gur*, without appreciably enhancing its price, is encouraged. White sugar so saved or released may be exported out of the country to secure foreign exchange to the general benefit of the country as a whole.

***Palm* gur**

The Palm *Gur* Adviser to the Government of India demonstrated how *gur* was prepared from the juice of palm trees. It is a delicious and nourishing type of *gur* as good in colour and form as the cane *gur*.

The production of palm *gur* is an ancient village industry of this country which flourished well, particularly in Bengal. Each palm tree can yield about 10 to 15 seers of *gur* annually. The process of preparing *gur* is quite simple. A cut or an incision is made in the stem of the tree and an earthen pot is fixed below it to receive the juice that oozes out and trickles into the pot. This juice is collected from a number of trees and after every 24 hours boiled, clarified and concentrated into *gur* in the usual way.

A booklet entitled *Palm Gur* published by the Ministry of Agriculture contains detailed information about this industry for the benefit of interested persons.

Compost-making

The various stages of compost preparation were shown with the help of pits and trenches. The conservation of liquid manure, i.e. animal urine was demonstrated by means of straw beds and sand-beds spread under animals and a placard with the words 'compost is incomplete without urine' was fixed at the compost pit to drive home the idea.

Animal nutrition

The Indian Veterinary Research Institute, Izatnagar, exhibited charts depicting original work on animal nutrition, feeding, etc. The rations worked out by them for a cow, a bullock and a bull are of practical utility to farmers and dairymen. The figures are given in the Table below :

Animal	Hay or dry fodder	Green grass or silage	Concentrate mixture
Cow (Maintenance)	8 lb.	25 lb.	1½ lb.
1 lb. of additional concentrate for every 2½ lb. of milk.			
Bullock (working for 6 hours.)	10 lb.	20 lb.	6½ lb.
Bull	10 lb.	30 lb.	5 lb.

The Institute has evolved a simple method of increasing both the nutritive value and the digestibility of wheat *bhoosa* and paddy straw by about 50 per cent by treating these straws for 20 to 24 hours with 1 per cent solution of caustic soda.

Dairy development

The Dairy Development Section of the Central Government demonstrated in an impressive way the sanitary *than* of cow (cowshed), clean and hygienic milking, processing of milk in its various stages, sterlization of dairy utensils and apparatus, preparation of various milk products and testing of milk against adulteration and contamination. A beautiful model of a largescale commercial dairy farm was also exhibited. The Cattle Utilization Section likewise exhibited various feeds and fodders and veterinary aids necessary for the proper feeding and health of the cattle.

Jaipur Agricultural Department

In the stall of the Jaipur State Agricultural Department was displayed a big soil and crop map of the State which showed at a glance the various zones of soil types and crops produced in these zones. Among some marvellous achievements of the Department, as evident from the charts displayed in the stall, mention may be made of the following :

(a) Co. 312 variety of sugarcane, which was introduced only five years back, has now not only replaced the entire area under local cane in this State but has also spread over more than four times the area originally occupied by the local variety.

(b) C. 591 wheat, introduced in 1945, has now occupied about half the total area under *desi* wheat and is expected to cover the entire area in the next couple of years.

The Agricultural Department of the State had also arranged a cane juice bar at which sugarcane juice was sold at a nominal cost of annas two per glass.

The Jaipur State and the United Provinces Agricultural Departments utilized the spacious courts housing their respective stalls with model fruit orchards exhibiting actual living plants, the different systems of spacing, the irrigation methods and the various methods of propagation.

Cattle show

A cattle show comprising of bulls, cows and heifers of Hariana, Namari and Nagauri breeds was held. There was a milking competition for cows. Cart and camel races, held for the first time in Jaipur, were arranged for the entertainment of villagers. This aroused considerable enthusiasm and interest and drew large crowds of spectators. There were as many as 29 entries for the cart race. Decent prizes were awarded to the winners of the first three positions in each race.

Visitors

As reported by the Exhibition Managing Committee, about 1,25,000 people visited the exhibition. It was indeed interesting to find visitors coming from the remotest corner of the country like, Kashmir, Assam, Junagadh, Tamilnad (Madras), Puri, etc. clad in their characteristic costumes. Besides several Congress leaders and distinguished visitors, the Hon'ble Prime Minister and the Hon'ble Deputy Prime Minister graced the exhibition with their presence.

Credit for the success of the *Gosewa* and Agriculture Section of the Exhibition goes to Shri Radha Krishnaji Bajaj and Shri B.S. Deshpande of the All-India *Gosewa* Sangh.

COCHIN

N. SANKARA MENON

THE State experienced a severe drought in the month of March, 1949 and the *Kole* and *Puncha* crops of paddy cultivated during this period suffered to a very great extent. All the sources of water dried up and the cultivators were rendered helpless. The crop over a considerable area dried up and the yield was reduced. The area under cultivation was about 20,000 acres and the total yield was expected to be even less than 50 per cent of the normal. This was a great blow both to the cultivators and to the Government in these days of food scarcity. The calamity was all the more severe since the cultivation of *Kole* and *Puncha* paddy

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entailed comparatively more expenditure than that required for paddy grown during the other seasons.

Subsidy on manures

A subsidy of 25 per cent on the selling price of manure was given by the Government in order that the manure might be utilized for the paddy crop. To induce the cultivators to use more manure and to increase production, this subsidy was raised to 50 per cent for manures to be used for *Kole* and *Puncha* paddy. The manure was issued in the form of a mixture consisting of groundnut cake, ammonium sulphate and bonemeal. The services of teachers trained in agriculture were requisitioned to conduct propaganda and supervise manuring. All the Officers of the Department concentrated their attention on this work during this period. About 400 tons of manure were sold and the manured crop came up well.

There was a serious attack of blight disease in the initial stages over a considerable area; but the crop recovered to a great extent later on. The drought was severe and the crop was considerably affected. Partly due to disease and mostly due to drought, manuring could not appreciably increase the yield.

Production of compost

Compost was prepared by a few Municipalities in the State. In order to augment food production the Government decided to open other centres for compost-making. An Officer was appointed to be in charge of this work alone. The Scheme has only just started working and it is expected that the production of this valuable manure will be increased considerably. Propaganda is conducted to prepare compost in villages also and all the Officers of the Department are inducing cultivators to convert all available organic refuse into manure. A sum of Rs. 16,500 has been provided by the Government for the preparation of compost in the State.

Green manure

The advantages of using *daincha* (*Sesbania aculeata*) as a green manure crop for paddy have been realized by a few cultivators in the Chittur Taluk. The yield can be considerably increased by using this crop as a green manure. The seed is not produced in the State and there was some difficulty in getting a supply from the adjoining Madras Province. One hundred bags of this seed were secured by the Agricultural Department for sale at half price to induce cultivators to grow this crop and increase food production.

Land Development Board

The production of more food is one of the most important problems confronting the country now and a larger area has to be put under cultivation if sufficient food is to be produced. The use of more manure, improved seeds and control of pests and diseases will increase the production to some extent; but there will be no lasting solution of the food problem if the area under cultivation is not increased. A Board has been formed to work out details for bringing more area of the State under food crops and it is estimated that 60,000 acres more can be put under food crops at an early date. The Honourable Prime Minister of the State who is in charge of Agriculture is the Chairman, and the Board had its first sitting recently. Details for bringing the scheme into operation are being worked out. The Diwan Peishkar, Director of Agriculture, Conservator of Forests and Irrigation Engineer are members of the Board. A major portion of the area will be available as a result of clearing the forests.

ASSAM

S. R. BAROOAH

THE Assam Government, recognizing the value of exhibitions as a means of propaganda to disseminate knowledge to the public at large, have initiated a string of agricultural exhibitions in the province. Thus, during the months of December, January and February a number of such exhibitions were held to popularize scientific agriculture.

Exhibitions at Titabar and Karimganj Farms

In these Government Farms both research and multiplication of paddy are being carried on. The exhibitions were held in the Farms on 1 December, 1948 and 16 January, 1949 respectively. The main purpose of the exhibition was to popularize recommended paddy varieties and also to demonstrate the best cultural methods in the fields. People from the neighbouring villages attended the exhibition in large numbers. A meeting was also convened where the improvemnts in agricultural practices were explained.

Exhibition at Gauhati

The annual agricultural and Industrial exhibition of the Department of Agriculture was held this year at Gauhati on 6, 7 and 8 January, 1949. It was a grand success despite bad weather. The Premier of Assam opened the exhibition with an appeal to the people in general to adopt the improved methods of agriculture. Besides Agriculture, exhibits of other departments like Industry, Basic Education, Forest, Public Health, Weaving, Sericulture, Tanneries and many others were exhibited. Next year it is proposed to hold the exhibition at Silchar, Cachar.

A number of exhibitions organized by the public were also held during these months, the most noteworthy being the one held at Bidyapur. This exhibition was organized by the people with the help of the *Zamindar*. The Agricultural Department also participated in the exhibition and demonstrated many improved methods of cultivation and improved seeds.

Boro and Bao paddy cultivation

Some parts of Assam are always flooded during the monsoon when many rivers are in spate. The worst affected part for the last few years is Nowgong district which gets flooded by the rivers Kapili and Kolong. Every year the Government has to rush food to this locality, and there is always a scarcity of food. This happens because the flood water comes during the growing season of the *Sali* (transplanted winter paddy). To remedy this situation the Department of Agriculture has been trying to popularize the cultivation of *Boro* and *Bao* paddy (spring and deep-water winter paddy).

There is a large acreage of land in Assam that can be brought under these two crops. The Department is trying very much to bring all the available *Boro* and *Bao* land under cultivation this year, and for this purpose the Agricultural Engineering Section has bought a number of pumps for irrigation. If *Boro* and *Bao* paddy is successfully cultivated in the available land, the floods will no longer be a menace to the cultivators, and the Province will be better off so far as food is concerned.

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Across the Borders

FARM BUDGETING

By P. C. DRUCE

PLANNING for the future is as important in farming as it is in any other type of business. The successful city businessman does not leave things to chance; he does not adopt a particular production programme for the year simply because he did the same thing the year before! He looks at his markets, his resources and his costs, and he decides on that programme of production which he anticipates will return him the greatest profit. Why should the farmer not do the same thing?

By the very nature of his work, every farmer, often perhaps without realizing it, does in fact, plan or prepare for the future. Frequently, however, no thought is given to definite planning, the farmer simply doing what was done in the previous season without paying any real regard to the fact that circumstances may have changed—and without making any attempt to ascertain whether the programme adopted in the previous season yielded the highest possible profit, having regard to the circumstances and to the amount of work and effort the farmer was prepared to expend. Often when plans are made they are not put on paper, nor are they carefully considered. Their preparation is, in fact, frequently far too haphazard to be sound.

There is no necessity for the planning of future farm operations to be either haphazard or unmethodical. A simple method is available whereby the farmer can plan for the future, either for the forthcoming year only or for a much longer period ahead. This method of technique is known as 'Farm Budgeting'.

What is a budget

A budget is simply an estimate of probable receipts and expected expenditure in a future period. That period may be three months, or a year, or five years; however, the most common period for which a budget, whether a farm budget or any other type of budget is prepared is for a period of twelve months.

Why prepare a budget?

A businessman periodically prepares, for his own use, a statement of probable receipts and expenditure, which will vary according to the production programme he decides upon, and he uses such a statement to ascertain the programme he should adopt so as to obtain the greatest possible profit during the period for which he is planning. In exactly the same way a farmer may put down on paper his anticipated receipts and expenses under various programmes or systems of farming, with the object of ascertaining which particular system of farming or combination of enterprises is likely to yield the greatest net profit under the circumstances which he anticipates will exist for a period of twelve months ahead, and in some cases for a longer period.

The preparation of a farm budget also enables the farmer to estimate in advance the returns that may reasonably be expected from any system of farming, under changed circumstances and conditions affecting farm costs and returns are continually changing.

Any budget is necessarily of a tentative nature and this applies to the businessman's budget just as much as it applies to a farm budget. Many farmers think that, because of the uncertainty which surrounds some of the factors used in the preparation of a farm budget, it is not worthwhile putting future programmes on paper. The fact remains that budgeting does enable a farmer to see the value of alternate methods of organization of production and to decide which is most likely to prove the most profitable.

There are a number of other specific advantages of farm budgeting. A budget helps a farmer:

(1) To determine in advance how much seed, fertilizer and other supplies he is likely to need during the year.

(2) To determine how much feed will be needed for livestock, how much must be bought, how much may be expected to be produced on the farm, and how much is likely to be available for sale.

(3) To determine the amount of cash that will be needed to operate the farm and also when it will be needed so that the necessary financial arrangements may be made.

(4) To determine the total net returns that may be expected, so that living expenses, payments or investments, may be adjusted accordingly.

(5) To keep a good balance between crops in a crop system of farming, and a good balance between crops and livestock in a crop and livestock system.

(6) To plan his labour requirements well in advance and, to a certain extent, it enables him to avoid unduly heavy casual labour requirements at any one particular period of time, in other words, the preparation of budget may help to spread labour requirements more evenly throughout the year.

Farm budgeting is really a very simple process, and the few hours that need to be devoted to it each year are likely to be well spent; it is conceivable that, on some occasions, budgeting may save the farmer who takes the trouble to undertake the small amount of work involved, many hundreds of pounds.—Reproduced from the *Agricultural Gazette of New South Wales*, September 1948.

CULTIVATION OF 'DIFFICULT' LAND

CULTIVATION of land infested with weeds or left with stubbles of previous crops is likely to be easier as a result of improvements made in the double plough recently invented by the Indian Agricultural Research Institute of the Central Ministry of Agriculture. The plough which consists of the bottoms only of two standard *desi* ploughs suitably coupled by means of an iron framework and pulled by a single central beam has been further modified now so that most difficult fields can be tackled with ease. It has been successfully tried in a number of cultivators holdings around Delhi.—(*P.I.B.*)

Home Gleanings

THE VETERINARIAN IN INDIA

By KARNAIL SINGH

THE value and importance of a veterinarian can be judged from the fact that two-thirds of the income of India is derived from animals. This is inspite of the solution that, as estimated by experts, 170 crores of rupees are wasted annually for the upkeep of useless livestock. Only veterinarians can improve these animals and thus can not only save this enormous sum annually but even add to it many times more by turning these useless creatures into workable ones.

Ours is an agricultural country. Agriculture and livestock go hand in hand. They are complementary and each is indispensable to the other. To promote agriculture, efficient labour-power is essential. The chief agency that supplies this motor-power is the ox. If we take away the ox or allow it to be inefficient there is no agriculture. Veterinarians have an indispensable place here.

Milk, which is nature's best, complete and thoroughly wholesome food both for children and adults, is a product of the animals. But the average milk yield of our cow is less than one seer, while it is nine seers in the case of cows of Denmark. It is shocking to know that (before the last war) the quantity of milk that we drew from 18 crores of animals was drawn from 2½ crores in Germany, 3½ crores in the U.S.A., 7½ crores in Great Britain and 7 crores in Russia. Denmark started to improve their cattle when the average milk yield of their cow was not better than the average milk yield of a milch cow in India today. Yet in less than fifty years the average yield of butter fat per cow has been raised from 88 lb. to 359 lb. per annum, i.e. more than four times. Similarly marked increases have been effected in other countries. There is no reason to believe that our cows would not be able to yield as much milk as the cows of other countries.

In spite of the fact that India has one-third of the cattle of the world, the average milk consumption per head of population is only 7 ounces, while it is 30 ounces in France, 35 in the U.S.A., 39 in Great Britain, 43 in Norway and 56 in New Zealand.

There seems to be some relation between milk consumption per head of population and the average age of man. The average longevity of an Indian with low milk consumption is 28 years, while that of the New Zealander with milk consumption of 56 ounces is about 70 years.

Infant mortality occurring in India is probably the highest. Similar relation as in the case of milk consumption and average longevity seems to exist here too. Here is the task for the veterinarian. For, he alone can help our fellow men to grow healthier with better brains and long life.

Indian sheep are of bad quality and their average live weight would be hardly sixty pounds. Their average wool yield is about 2 lb. which is very low. As against this, sheep of European countries are of superior quality, their average live weight and wool yield are about three times more than those of Indian sheep. India has six per cent of the total number of sheep of the world but produces only two per cent of the total wool of the world, that is three times less when compared with the number of sheep it has. This too is the task of the veterinarian, who by turning the sheep into as good as those of other advanced countries will supply better and more woollen clothes and more meat as well.

The same is the case with goats and poultry. They also need improvement. By improving these, the veterinarians will be able to make milk and eggs within the reach of everybody.

Let us now consider the losses that we have to meet due to some of the major contagious diseases of the animals.

There are three main contagious diseases that generally occur as epidemics. These are rinderpest, haemorrhagic septicæmia and foot-and-mouth. These cause immense losses to India. The deaths recorded in 1926-27 due to rinderpest were 202·2 thousands, haemorrhagic septicæmia 36·4 thousands and foot-and-mouth 13·6 thousands. As a matter of fact these figures are far below the actual state of affairs. This is clearly shown by the examination of the figures from Burma, in a part of which the notification of deaths from cattle diseases was made compulsory. There it was found that if these figures were believed to be correct then the calculated average age of an animal would come to 54 years which is nothing but absurd. The average age of cattle is probably six years which is nine times less than the average age calculated in Burma. So roughly we can say that actual deaths are nine times more than those reported. Perhaps still heavier losses are sustained by the cultivator indirectly, as, in case of foot-and-mouth; for one animal that dies 99 may be temporarily incapacitated and also there is loss due to imperfect cultivation and decrease in milk too. Tnere are also other numerous known and unknown parasitic and protozoan diseases, the losses due to which also are fairly heavy. The loss due to warble-fly infestation has been estimated even on a conservative estimate to be 1½ crores of rupees annually. These diseases have been practically stamped out in European countries and there the losses due to these amount to a negligible quantity compared to the losses in India. There is no reason to believe that we should not be able to accomplish what others have. Thus we see that it is a veterinarian only who can save the country of the tremendous loss by eradicating diseases, etc.

There are a number of diseases like T.B., rabies, anthrax, undulant fever, actinomycosis, foot-and-mouth, etc. that are communicable from animals to men. There are also the so-called milk-borne diseases such as cholera, diptheria, typhoid, scarlet fever, septic sore throat, that may be transmitted through the agency of milk from one individual to another. Thus the veterinarians, by eradicating such diseases in animals and supplying scrupulously clean milk, will reduce the incidence of these in human beings too.

I think this should suffice to convince any impartial judge of the great importance of veterinarians in India. As a matter of fact the key to the prosperity of India lies in the hands of the veterinarians.

Yet we see that the veterinarians are ignored everywhere. No due regard is paid to them. They are looked down upon by the majority of the people. This is all due to the ignorance of the public who do not understand their worth. Even some veterinarians think that theirs is an odd job. They think themselves to be unfortunate ones to join this profession. But the veterinary profession is economically the most productive and its science an illuminating one. Even then veterinarians are not properly paid by the Government.

Let bygones be bygones. Let us look to the future with hope. For we have now at the helm of affairs genuine men who will pay attention to these. Up till now the most important things were the most neglected. So the veterinarians have been neglected to the utmost. Today they are so downtrodden that a veterinarian often hesitates to disclose his profession.

The reader will see from the above that most important problems confront the veterinarian. These are :

(1) Production of milk and its by-products.

(2) Improvement of cattle and the supply of bullock for agricultural purposes.

(3) Supply of meat by improving sheep and goats.

(4) Supply of wool by improving the sheep.

(5) Supply of eggs by improving poultry.

(6) Control of contagious and non-contagious diseases of animals.

(7) Eradication of diseases common to man and animals.

(8) Eradication of milk-borne diseases.

(9) Treatment of sick animals.

Besides this, the veterinarian has to supply beef and pork to persons who relish it.

These are important problems for the nation. If our country is to progress and progress soon, the most efficient and competent persons should be induced to join the veterinary profession. But unfortunately those who generally fail to find a place elsewhere join this profession. To attract efficient and competent persons, it is essential that the status of the veterinarians must be raised. I hope leaders of the nation and various *go-seva* workers will consider this subject with zeal.—Reproduced from *Harijan*, June 19, 1949.

GUR

By DEVENDRA KUMAR GUPTA

THAT face value is often deceptive is perfectly true at least in the case of jaggery or *gur*. Sugar has been able to beat jaggery out of the field not only because the modern mechanized trade was at its back but also because we believe in the 'colour bar' even in our edibles. In the beginning of sugar manufacture our country people were very sceptic about its use, they only did not know that later science will prove that they were right. Sugar is cent per cent sucrose—the sweet carbohydrate—a concentrated fuel. It supplies only calories. Dr Wilder of the Council of Foods and Nutrition, U.S.A., years ago stated that sugar was not among the recommended foods, for sugar supplies nothing but calories and what is worse is that to liberate these calories sugar saps the vitamins provided by other foods.

But *gur* is something different. It is sugarcane juice minus much of its water. It retains all the mineral salts and other nutrients present in the juice.

	Sugar	*gur*
Sucrose ...	99·7	59·71
Glucose ...	Nil	21·28
Minerals	0·02	3·36
Moisture	0·04	8·86

Dr Kali Das Mitra of Patna states that 'Because of its mineral content however small, *gur* is a superior article of diet as compared to sugar'. The present day student of nutrition lays great stress on the presence of 'trace elements' in the diet. One analysis of *gur* furnished by the Director, Nutrition Research, Coonoor (S.I.) gives the following quantities of the four minerals which play an important role in the metabolic processes more especially calcium which is presumably present in an organic form :

Minerals	Mg. per 100 gm. of *gur*
Calcium	75 mg.
Phosphorus	38 mg.
Iron	11 mg.
Copper	56 mg.

Thus the dark colour which degrades *gur* is due to much what is good in it. The misunderstanding that it is due to impurities is wrong. This colour is mostly due to these health giving nutrients like mineral salts, etc.

You will find nearly that one-fifth of the total sugar in *gur* is in the form of glucose or fructose. It will thus be seen that injestion of *gur* possesses the advantage over that of sugar in that its glucose content saves the organ concerned the exertion required to injest the corresponding amount of sucrose injested.

Diabetes has increased tremendously in recent years and a part at any rate of this increase may be ascribed to the use of white sugar to the exclusion of *gur*. White sugar is also one of the causes of dental decay.

Experiments reports from Hawaii in 1933 show that cane molasses is a good source of vitamin B_1 and B_2 and these must be also present in *gur*. Similar is the experience of Czechoslovakia and Japan.

All this evidence and the accumulated experience of generations of the village people proves it beyond doubt that whereas the use of mill-sugar leads to exhaustion, dental decay and diseases like diabetes and anaemia, the brown jaggery of *gur* gives man the gifts of health-vitamins A, B_1, B_2, and minerals like calcium, iron and phosphorus and nutrients like carotene, glucose, fructose, proteins and fats, small though they may be.—Reproduced from *Gram Udog Patrika*, Wardha, July 1949.

Book Reviews

RURAL PROBLEMS IN MADRAS (MONOGRAPH).........

By S. Y. KRISHNASWAMY (Printed by the Superintendent, Government Press, Madras, 4th edition, 1947 : Rs. 5).

THIS is a volume covering 545 pages with 13 chapters, besides conclusion, 33 appendices and synopsis. There are 32 charts, diagrams and photographs devoted to diverse yet vital subjects. All problems connected with agriculture and animal husbandry and general rural economy have been dealt with in this highly fascinating and useful monograph.

Following the Conference on Rural Life in Europe under the auspices of the League of Nations the preparation of a monograph for Madras was undertaken by Sir S. V. Ramamurty, K.C.I.E., I.C.S., who has given an illuminating introduction to the book.

Although the work was initiated by Sir S. V. Ramamurty the 'work has been done by Mr. Krishnaswami' who deserves to be congratulated. The book bristles with a mass of useful information and from the agricultural standpoint a very welcome feature is an appreciation of the technical aspect and importance of science to agriculture. The reviewer has come across men even in the Agricultural Department with pessimistic views, and sometimes specialist in one line deprecating the work or utility of that of another. The attitude of men on the propaganda side towards research has not been and is not always what it should be. It is, therefore, a highly gratifying matter that the author, an I.C.S. officer, has put his finger on the right spot and has so admirably tried to impress the value of scientific aid to agriculture. His remarks, viz. that 'physical and chemical properties of soil play a dominant part' (p. 113), and the need for a scientific study of soils in relation to crop 'production cannot be over emphasized' (p. 114) are instances of a broader outlook of which India is badly in need. Mr. Krishnaswamy rightly emphasizes that 'what is required is not a mere soil study but a study in relation to crop, region by region' (p. 126).

There is so much in this monograph that a complete review will occupy a large space. The following therefore refers to the more notable features taken at random.

Out of a total population of over 49 millions in Madras, 41 millions live in villages (p. 13). The proportion of rural population to total population is 84 per cent. There are 35,430 villages in the province. Fifty years ago the total urban population was 3½ millions; today it is nearer 8 millions. The old aggregations of village life have changed from being a unit of economics and civilization to a unit of agricultural production only. Time was (p. 15) when the culture of the country was developed in the village and received its reward in the courts of kings. The time is now when the results of studies made in urban surroundings have to be carried to the village for the benefit of the cultivator. The reviewer is in complete agreement with the author; he strongly feels that however we may desire it will be impossible to return to or revive the old order of village economy or what was once village sufficiency.

The incedence of malaria as a cause sickness, death and economic loss is so heavy as to nearly overtop the combined effects of all epidemics like cholera, plague and small-pox. Yet Madras is not certainly as malarious as some parts of Eastern India.

Infant mortality per thousand is 172 as compared to 172 for undivided India and is more than three times that of the United Kingdom. Enquiry in the districts of Madras Madura, Coimbatore and Trichinopoly showed that in groups with incomes under Rs. 25 the mortality rate was 120, under Rs. 50, 102, and over Rs. 50, 84. It is not however clear how the average (given in p. 21 and cited above) should exceed the maximum. Possibly this is a typographical error.

Out of every 1,000 persons 445 have no work. Out of the remaining 555, 270 are dependent on agriculture, 77 on industry, trade and transport, 11 on public administration and 197 on miscellaneous occupations. In 1921, 71 per cent of the population was dependent on agriculture, in 1931 it is shown to be 50 per cent; this variation is however too wide and is due to a different system of classification.

Within agriculture out of every 1,000 persons engaged 429 are agricultural labourers, 390 are cultivating owners, 120 cultivating tenants, 34 non-cultivating owners and 16 non-cultivating tenants. The evil of absentee landlordism is not as prevalent as one would suppose. This evil persists in the rich deltaic areas.

There is an improvement in the employment afforded by minor industries connected with repairing of motor vehicles, construction and repair of roads and bridges.

By far the best cultivators are the Nayudus and Gownders. The scheduled castes, forming eight millions, are the agricultural labourers and are in larger numbers in South Arcot, Tanjore and Godavari districts. The Muslims as a whole have not impressed themselves in rural avocation except in Malabar. The Christians are relatively in large numbers in Tinnevelly and Guntur. Several missionary organizations have taken keen interest in rural reconstruction of which the Y.M.C.A. Rural Reconstruction Centre at Ramnathpuram has been said to be a standing illustration.

The coastal districts of Vizagapatam, Godavari, Tinnevelly, Malabar, Tanjore, Kistna and Madura offer avenues of emigration to Ceylon, Malay, Fiji, Trinidad and Jamaica, British Guiana, South Africa and Mauritius and emigration is quite appreciable. For instance, in Fiji out of a total of 83,289 Indian population, Madras accounted for 23,500 in 1934 coming next to the United Provinces with 50,500.

In Madras the different forms of land tenure system are the Zamindari tenure, the Ryotwari tenure, the Inams, the Malabar Land Tenures and the Muli Tenure of South Kanara. The Monograph states that 'after the Permanent Settlement the worst sufferer, however, was the ryot' (p. 38). Taking the holdings on all systems the area of cultivated land per cultivator is 5·99 acres and the average size of holding is 4·5 acres. In consequence of the laws of inheritance and pressure of population fragmentation of holding has been accentuated.

In matters of irrigation the Province has facilities to irrigate between 11 and 12 million acres with 30 canal projects, 22 reservoir projects, 33,086 tanks and 728,092 wells. One of the important irrigation works is the Grand Anicut on the Cauvery at the head of the delta. This is the oldest work in the delta built many centuries ago by the Chola kings and is an amazing tribute of wisdom and skill of the ancient engineers. The development of well irrigation has been largely due to the exemption of additional taxation on private improvements. The author has discussed the irrigation policy of Government and has rightly remarked that in a country where so much is dependent on the monsoon and where the monsoon is notoriously capricious, reorientation of the policy is needed more to affect the people beneficially than to yield larger revenue returns.

South Kanara and Malabar on the West Coast and Godavari, Kistna and Tanjore on the East Coast may be considered to be immune from famine, though in Malabar the pressure of population is reacting adversely.

Attention has already been drawn to the importance attached by the author to the technical side of and scientific aid to agriculture. With regard to phospate Madras is fortunate in having a two-million ton deposit of mineral rock phosphate in the Trichinopoly district. Stress has been rightly given on nitrogen deficiency which is a problem. The author gives an estimate of the deficit in Madras which is to the tune of 605,000 tons of nitrogen, 210,000 tons of phosphoric acid and 641,000 tons of potash (p. 121).

The country plough continues to be the main implement of cultivation. Out of 3,878,868 ploughs, 52,184 or a little over 1 per cent are iron ploughs. A number of useful implements have been devised such as the bund-former, termeric polisher, etc.

The author has struck the right note in emphasizing that the 'major problem at the moment is not so much deficiency in acreage as deficiency in yield'. We very often lose sight of the fact that in India the yield per unit area is very low. During the last 20 years the New York State acreage devoted to potato has been cut to half, yet the total tonnage produced has been doubled, in other words the yield per unit area has been quadrupled. In Britain the yield in 1943-44 as compared to 1934-38 was raised by 109 per cent in the case of wheat, 115 per cent in the case of barley, and 102 per cent in the case of potato. The yields of other crops were also raised considerably. In India we have very few instances of similar achievements.

The author is of opinion that most of the ryots are illiterate and leaflets are of no use to them. It is necessary therefore to go actually to the ryot and show him, and not wait for him to come and be told. This may be by exhibitions on all important occasions and festivals.

The major deficits for providing a balanced diet are in pulses, vegetables, fruits, milk, fats and oils and meat and fish. The deficit in pulses requires to be made up by increasing production sixfold.

Madras is fortunate in having some fine breeds of cattle but unfortunately encroachment on grazing and fodder areas for food and commercial crops is leading to their deterioration. As in other parts of India the number of cattle per 100 acres of net sown area is very high, being 69 as compared to 67, 38 and 25 respectively for India (undivided), Holland and Egypt. The Madras cultivator is more fertilizer minded and has a better cattle conscience. The supplementary feeding with a mineral mixture is now an accepted practice among advanced agriculturists.

The author points out that in the rural economy of the province no other improvement can bring about so good results in bettering the status of the farmer as the development of the livestock industry.

After dealing with agriculture and livestock the author has directed his attention to rural industries which he divides into (1) wholetime occupation, (2) those subsidiary to agriculture and (3) cottage industries. The handloom industry occupies the premier place having the largest number of looms as compared to all other provinces except Assam. The development of power textile is a definite trend. The handloom weavers of the province consume about 25 per cent of the dyes consumed in the undivided India. Hosiery, lace and embroidery, sericulture, ericulture, woollen industry, fibres from coconut, hemp, palmyra and aloe, hand-made paper making, metal industry, wood-work, boat-building, cane and rattan work, basket-making, leaf-platter making, stone carving, soapstone ware making, slate making (also slate pencil), glass bangle industry, ceramic industry, pottery, cigar manufacture, beedi manufacture, leather industry, dolls and toys making, ivory work, match industry, button industry, bee keeping, sheep breeding, etc. provide numerous avenues of occupation to the hard working population of the province.

Important suggestions and comments have been given by the author regarding these rural industries. These apply to Madras as elsewhere and indicate possibilities whereby wholesale dependence on land can be minimized.

In the chapter on 'The Financing of Agriculture and the Development of Cooperation' the author states amongst others that there are 35,837 villages whereas there are only 10,792 societies so that the remaining 25,045 villages (i.e. 70 per cent) require cooperative societies to be organized. He also presents data (p. 360) showing that a substantial portion (about 63 per cent) of rural debt is unproductive; this is a matter of anxiety. Madras has to its credit other forms of societies, such as Agricultural Improvement Societies, Land Reclamation Societies, etc.

According to the census of 1931, 16 per cent of the males and 2½ per cent of the females were literate. In 1941 the literacy per 1,000 population was recorded at 130, and the same per 1,000 females was 63. Twenty-five years ago only 1·8 per cent of the female population attended school as against 4·6 per cent in 1942. The paucity is due to the general feeling that 'marriage and motherhood is the chief, if not the only career for women and that the education of girls should be limited to this objective'. In 1932 there were 770 public libraries, the number increased to 1,340 in 1944. The number of books and journals totalled 891,389 and over 2¼ million persons made use of them as against 1¼ millions in 1932.

The living room in the houses is quite inadequate and contrary to popular impression actual congestion in some of the villages is greater than in the towns specially in the deltaic tracts. Both in towns and villages the position is lamentable in regard to the quality of houses and the area of habitable space. The author stresses that the first essential for rural housing is to undertake a comprehensive survey.

Before conclusion it may be said that that the book is replete with a mass of useful information and will serve as a guide to other provinces to undertake similar work. The aim of the book is to afford a background to those who desire to improve the economy of rural life'. We have men with vision but without facts. Similarly there are men possessed with fact but without vision. A blending of both is the first essential for success in rural improvement'. (I.C.)

* * *

STARTING AND MANAGING A FARM

By C. M. Hampson (Published by McGraw-Hill Book Company Inc., New York, pp. 244, $ 2.60).

THE book is divided into three parts. Part I is divided into five chapters and deals with what one can expect from farming. Part II, divided into five chapters, deals with part-time farming with suggestions as to how to select and manage such a farm. Part III has been divided into eight chapters and deals with a large commercial farm. This is the most important part and deals with the various kinds of large farm and methods of selecting and managing them. The interesting features of the book is that there is a summary at the end of each chapter, giving briefly the various points discussed. The material given in the book based on 35,000 farm records from 31 States is applicable to all common types of farming in all parts of the United States. It describes what kind and size of farm to have, where and when to start and how to manage it to get the greatest return. Though the data given in the book relate to farming in the U.S.A. the general principles discussed will apply equally to farming under Indian conditions. It is, therefore, commended both to the students in Agriculture and the practical farmers. (K.S.)

COVER ILLUSTRATION

Pre-monsoon
cultivation in Bombay Province

CAN THE WORLD PRODUCE ENOUGH FOOD ?

CAN the world produce enough food to feed its maximum potential population? This question of prime importance to many countries is discussed in a pamphlet entitled *Food And The People*, published by the Bureau of Current Affairs.

Dr Aldous Huxley says that the only alternative to worldwide starvation is reduction of numbers almost everywhere. Sir John Russell, President of the British Association and one of the world's greatest authorities on agriculture, disagrees. Both viewpoints are set out in the pamphlet.

Says Dr Huxley : If " we are to avoid starvation there must be a ' world population policy ' based on birth control ". Meanwhile he calls for the resources of applied science to be mobilized for the relief of the world's hunger.

Sir John Russell agrees with the latter proposition but maintains that the world can keep pace in food production with any foreseeable increase in population.

Of all the food problems, he points out, those of India and Pakistan are probably the most difficult; yet there still remains uncultivated land in the sub-continent equal to two-thirds of the area now being farmed.

Moreover, increasing the output per man and per acre may well prove to be the real answer to the world's food problems and there is much work being done along these lines in India and Pakistan.

It is estimated, he continues, that 90 per cent of food is consumed on or near the land of its production and only some 10 per cent goes on the world market.

Should further acreage be required, however, Sir John calls attention to the fact that only some 10 per cent at the most of the world's land area is yet used for food production. There yet remain enormous areas, which, with irrigation, the use of insecticides and modern equipment, could be brought under the plough.

Britain, he considers, sets an excellent example of land utilization, the yield per acre and output per man there being already among the highest in Europe and three or four times greater than in the U.S.S.R. Britain's average yield of potatoes is about seven tons per acre, but a good farmer can easily get ten ; the average milk yield in Britain is 600 gallons, but good dairy farming produces upwards of 1,000; wheat averages 19 cwt. per acre against 9·2 cwt. in Canada and the U.S.A. and 5·6 cwt. in Russia.

Another way of augmenting food supplies is by increasing the war on pests. The F.A.O. has estimated that mites, pests and rodents destroy 65 million tons of grain per year.

The conclusion seems to be that with proper management, more scientific application and better planning, the world need never starve provided that Governments work together and food production is given the priority it deserves. (*B.I.S.*)

APPLICATIONAL COURSE IN AGRICULTURAL STATISTICS

THE following students, deputed by different Departments of Provincial State Governments, Ministries of Central Government, Institutes, etc. have passed the final examination of the Applicational Course in Agricultural Statistics conducted by the Indian Council of Agricultural Research in May, 1949.

			Division
1.	G. D. Chakrabarty	Department of Agriculture, Forests and Fisheries, West Bengal	First
2.	P. R. Yeri	Agriculture and Rural Development Department, Bombay	First
3.	R. Devarajan	Government of Cochin	First
4.	Gurdial Singh	Horticulture Department, Patiala and East Punjab States Union	Second
5.	K. N. Vali	Veterinary Department, East Punjab	Second
6.	A. G. Kavitkar	Indian Agricultural Research Institute, New Delhi	Second
7.	J. C. Victor	Animal Husbandry Department, Madras	Second
8.	M. L. Shukla	Department of Agriculture, United Provinces	Second
9.	J. S. Srivastava	Animal Husbandry Department, United Provinces	Second
10.	M. Gangarudriah	The Government of Mysore	Third
11.	K. S. Sinha	Department of Agriculture, Bihar	Third
12.	R. N. Chaturvedi	P.W.D. (Irrigation Branch), United Provinces	Third

—(I.C.A.R.)

DIPLOMA COURSE IN FRUIT AND VEGETABLE PRESERVATION

THE following students have passed the Final Examination of the Diploma Course in Fruit and Vegetable Preservation of the Indian Institute of Fruit Technology, New Delhi, of the Indian Council of Agricultural Research for the session 1948-49. The names are in order of merit and the figures within brackets represent the marks secured by a candidate.

First division

Shashikant Mehta (536); Desh Raj Sharma (492); Balkrishan Sethi (483); Dhara Singh Rana (473).

Second division

Maghar Singh (469); Dalip Singh (469); Ratan Lal Dang (464); R. D. Ghosh (460); A. C. Batra (457); K. C. Virmani (436); Vijay Pardhan (428); M. M. Mehta (425); Satwant Singh (425); H. B. Pingley (415); Sikandar Singh (408); and K. Venkateswarlu (389).

—(I.C.A.R.)

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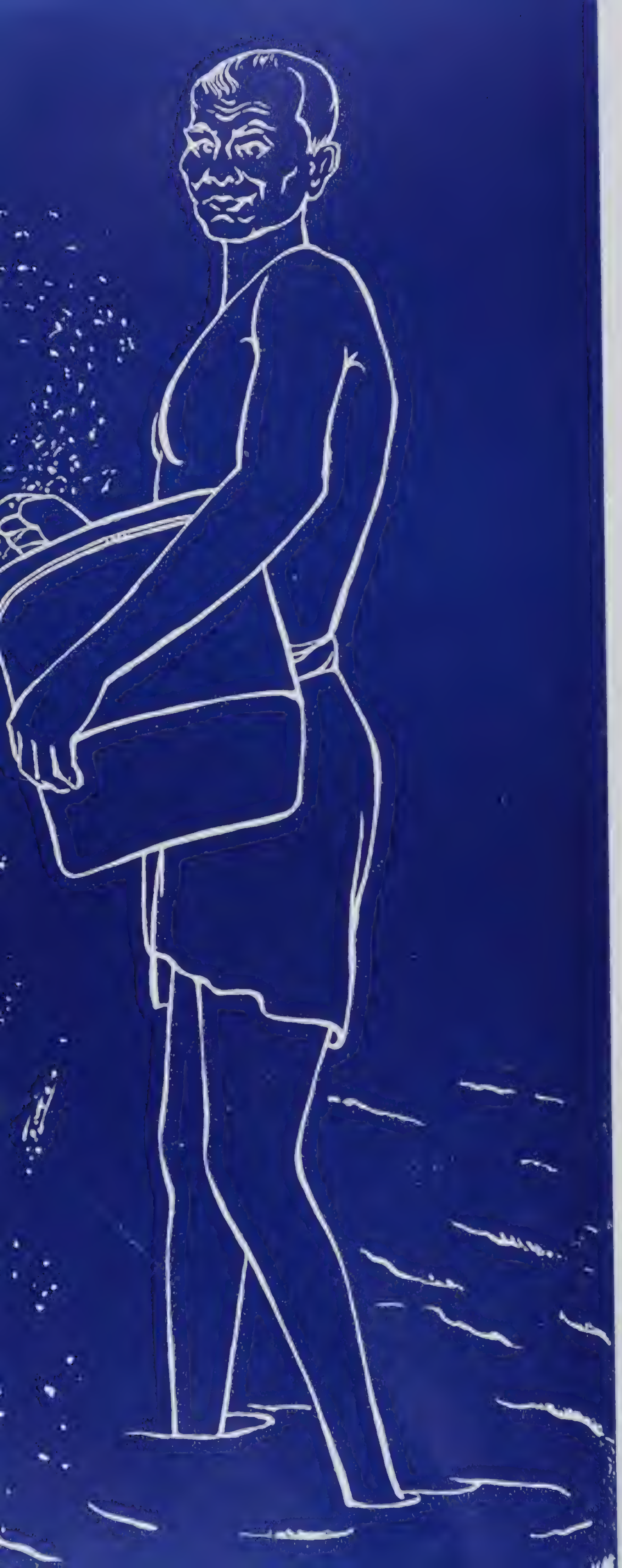

Sowing the rice seed. 'Ura' cultivator of Ranchi, Bihar

INDIAN FARMING

OCTOBER, 1949

Vol. X No. 10

COMBATING THE FOOD SHORTAGE*

I HAVE troubled you all, Hon'ble Ministers from Provinces and States and your officials to meet for the first time after the last Conference of Food Ministers in September, 1948. Two important events have taken place since then which have necessitated our meeting today. In the first place, we have had nearly 10 months' experience of the re-imposition of control on food and it will be useful to consider what further steps have to be taken in the light of the experience of these months to reach the objective we had in view when we reimposed control. The second important event has been the definite decision arrived at by the Government of India in March last not to import foodgrains after 1951 except in case of widespread failure of crops or for the purpose of building up a grain reserve. This decision has naturally very important implications in regard to our production and procurement plans.

I will deal with the second event first. The imports of foodgrains were becoming an unbearably heavy burden on our exchange resources. This burden had to be removed. This could only be done by increasing internal production. It was also obvious that in the event of any emergency of the nature of a war, India would be helpless if it depended on imported foodgrains. We are also spending away a large amount on shipping freight on foreign grains. The Government of India therefore decided in March last to stop the import of foodgrains and increase the production of food within the country and reach a target by 1951 which would enable us to feed the Nation at the present nutritional level without imports. To achieve this object both the deficit as well as the surplus provinces have to play a big part. Surplus provinces like the Central Provinces, Orissa, Assam and some of the States have great potentialities for increasing their production. On that increase depends the future of the deficit provinces. The deficit provinces also have to put forth unusual effort. It is essential that in a matter like this one should plan ahead. We have prepared a tentative chart of annual targets of increased procurement for all the units of India. It is my view that procurement in the case of several units has been underestimated. I feel confident that they will procure more than has been indicated in that chart.

The Prime Minister's broadcast has given a big push to the production drive and the emergency machinery which is being set up in the Centre and the Provinces of Food Production Commissioners with special powers is already getting busy with the task of implementing the self-sufficiency programme. Each unit can achieve at least a 15 per cent increase. Several units can go even beyond that figure. The tentative chart we have prepared is in no sense a sacrosanct document. The targets indicated there are for your discussion and they have to be adjusted from season to season but I hope they will be regarded as minimum targets for each unit pending any further alterations. As I have said in some cases there may be a greater increase than has been proposed. It is also possible that in some cases there may have to be a reduction but one decision is definite and certain and that is that unless there is an unforeseen adverse development in a particular area, provinces and States must plan for substantial increase in local production and procurement. I hope many units will be self-supporting by 1951 and that the surplus regions will produce enough to supply the needs of such units as still remain deficit. In the vital campaign of food production and food procurement, the surplus and deficit provinces will not, I hope, pull in opposite directions but will share the same attitude in regard to the national campaign for self-dependence. The economic interests of deficit and surplus provinces are in more than one way interconnected and inter-dependent and joint effort in the common national cause is absolutely essential.

---

*Speech delivered by Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture at the Food Ministers' Conference held on 1 August 1949.

The other event since we met last to which I have made a reference was the re-imposition of control. This was intended to fight inflation. Food is an important item in the cost of living. The cost of living of industrial labour and the urban middle class is an important matter for any country. It is therefore necessary to see how far we have succeeded in reducing the cost of food for this sector of the Nation's population. It is true that the prices of foodgrains have not reached the level of December 1947, but the prices of wheat, rice and *bajra* have fallen below the pre-control level as you will notice from the papers we have circulated. The price of *jowar* has, however, shown a reverse tendency. This is due to great shortage in production of *jowar* in the Central Provinces and the United Provinces on account of unfavourable weather conditions.

The rationed population has greatly increased since the re-imposition of control. It stood at 133 million about a month ago. This portion of the population is thus having the advantage of controlled price. Of this nearly 47·7 millions, i.e. nearly five crores constitute the urban rationed population. Thus practically all industrial labour and the urban middle class are covered by controlled ration and are getting foodgrains at materially reduced price than before re-control.

In the East Punjab, Bombay and Madras, the cost of rice for the rationed urban population has been reduced by nearly 50 per cent, though it is still very high as compared with pre-war conditions. In other provinces the percentage of fall is less, but it is still substantial except in the case of the Central Provinces where the price of rice has always been low compared with other provinces. In the case of wheat also there has been a material reduction in the price level generally for the urban population.

We have not, however, attained our objective of further reducing level of prices for foodgrains. We will be fixing the *kharif* price in October 1949 and the *rabi* grain prices about April next year. There is likelihood of a progressive fall in the world price of foodgrains, and the imported grain for the next two years will probably be available at much reduced prices. This cannot but influence our internal price of foodgrains. On the other hand, there is a demand for stabilization of agricultural prices at a reasonable level and for correlating the price to the cost of production and cost of living of the agricultural producer. There must however be a proper balancing of all relevant economic factors before reaching a final decision and that decision must be guided by the overriding consideration of placing our national economy on a sound and solid basis.

We have one other important item on the agenda relating to the methods of procurement and rationing adopted in different provinces. I would venture to suggest that greater uniformity than now exists may be secured in our systems of procurement and rationing. The experience of those provinces and States where procurement has been satisfactory is available to others and by a free exchange of views, we may try to reach a decision in regard to methods of procurement which may yield good results all round.

There are also certain proposals before the Conference with regard to the extent of rationing to be aimed at. It has been suggested that if Government undertakes responsibility for a smaller sector of the population but supplies it with a larger ration, it might lead to better controlled prices and provide for more effective enforcement of food laws. I feel the question of uniformity of procurement and change in the rationing arrangements important enough for a Committee being appointed to make recommendations.

There are other items on the agenda to which I may briefly refer. More than one country has made up its food deficit by introducing the subsidiary foods in the national diet and since from the yield and nutritional point of view everything can be said in their favour, it is essential that the Provincial Governments should plan for increased production of the subsidiary foods and work out arrangements by which they can be adequately introduced in the diet of the urban population. The Subsidiary Foods Committee of the Food Ministry has prepared a big programme in which the cooperation of the Provincial Governments is invited.

As you all know, our Prime Minister in his broadcast on food about a month ago emphasized the importance of reducing the consumption of rice with a view to reduce the heavy imports of rice from abroad for which we have to pay much higher rates than for wheat. There will be substantial saving if the use of wheat is popularized in place of rice. We would like to have your advice as to how this can be best achieved and also how such difficulties as some of you may apprehend can best be overcome. There is also the question of use of unpolished rice. I know that the distribution of this rice has led to a certain measure of unpopularity of the rationing system. We are considering measures for avoiding polished rice and giving to the people under-polished rice. This change requires the working out of technical details with regard to the milling operations, and it is proposed to secure full information as to the methods of milling in each province and State and determine in what manner they can be adjusted to secure the results we have in view. If the programme of self-sufficiency is to succeed, we must adopt all methods to save as much food as possible. The tightening of the austerity measures must be fully considered and all waste avoided. So also it is necessary to go more thoroughly than has been done hitherto into the question of quality of foodgrains issued from the ration shops. There have been widespread complaints that bad quality of grain is being served to the people. It is essential to keep a continuous check on the quality of imported foodgrains from the time of unloading of the steamers till it is issued from the ration shops to the consumer. We propose with your cooperation to take up this matter systematically and revise and extend the existing arrangements for maintaining the quality of the foodgrains.

There is also the last item on the agenda relating to the need for greater publicity in regard to food matters. All our programmes of self-sufficiency, better procurement and more satisfactory distribution need special and adequate publicity. I would suggest that all the last five items on our agenda, i.e. those relating to ban on polished rice, reduction of rice consumption, austerity measures, control of quality of grains and publicity might be referred to a Committee of officials to give us their report as to what steps can be taken in regard to these.

In the end, I may express the hope that at this Conference we will be as informal in our discussions as possible and will dispose of our whole agenda satisfactorily.

ARAB STUDS TO IMPROVE AUSTRALIAN FARM HORSES

THE New South Wales Department of Agriculture hopes to improve the standard of stock horses and of show horse types by the establishment of two Arab thoroughbred studs, one at the Wagga Agricultural College and the second at the Yanco experimental farm.

A complete stud of Arab mares, one of the most outstanding in Australia, has been bought and is being moved to Wagga. The stallion for this stud is said to be one of the best Arabs exported from Britain. Location of the stud at the Wagga Agricultural College will enable students there to study the breeding of Arab strains at first hand.—*Australian Agricultural Newsletter*, No. AGN/262.

THE CONTROL OF GRASSHOPPER PESTS OF CEREAL CROPS

By HEM SINGH PRUTHI

AMONG the pests of paddy, millets, etc. grasshoppers are very important. At irregular intervals serious outbreaks of these pests occur over large areas and the losses are indeed very high; for example, in 1947 the whole of the rice area in Belgaum district of Bombay Province was infested with the Rice-grasshopper and the yield in some parts fell below five per cent. Even during the years which are not marked by outbreaks, the losses due to them are sufficient to class them as major pests. Grasshoppers are important all over the world. During the ten-year period of 1936-46, the damage to crops by grasshoppers in the U.S.A. is estimated at about Rs. 250 crores. In Australia the damage is in about the same proportion. The damage is much more in India because our Agriculture and Plant Protection Organizations are yet not as well-developed as in those countries.

The grasshoppers which greatly damage the cereal crops in India are: (i) Rice-grasshopper, (ii) *Phadka* and (iii) the Deccan Wingless-grasshopper. Very often, associated with the Rice-grasshopper is the allied species *H. oryzivorus*, Bal. Of these, the Rice-grasshopper is common in the more moist areas and infests mainly paddy and sometimes sugarcane. On the other hand, *Phadka* and the Deccan Wingless-grasshoppers are confined to the drier areas and devastate rain-fed crops like maize, *jowar*, *bajra* and small millets.

HEM SINGH PRUTHI, M.Sc., Ph. D. & Sc. D. (Cantab.), F.R.A.S.B., F.N.I., is Plant Protection Adviser to the Government of India and Head of the Directorate of Plant Protection Quarantine and Storage, Ministry of Agriculture.

Life-history of the grasshoppers in general

All the three grasshoppers have some common features in their life-histories. The eggs are laid in the soil in clusters or pods, some time before the setting in of the winter season. They lie there till after the break of the monsoon rains in the following year. When the soil becomes sufficiently moist, development inside the eggs proceeds quickly and in 10 to 15 days' time, the tiny hoppers emerge from the eggs and wriggle out to the surface of the soil. Soon feeding becomes their main pre-occupation. As they grow, they cast off their outer skin, which they do six to eight times, till in seven to nine weeks they become full-grown. Some more time passes before they become sexually mature and then, after mating, the females begin to lay eggs. Each female may lay egg clusters two to four times in her life-time and each cluster may consist of 30 to 75 elongate eggs. All these species of grasshoppers have only one generation in the year. The winter and the pre-monsoon parts of the following year are passed in the egg-stage as described above and practically there are no hoppers at that time of the year.

Grasshoppers start feeding soon after the emergence from eggs and continue doing so till their death. They start feeding on young leaves of paddy, maize, *jowar*, etc. reducing them to skeleton and then they attack the young ears and cobs and thus damage the crops. A more detailed account of the various grasshoppers is given below.

The Rice-grasshopper

The Rice-grasshopper (*Hieroglyphus banian*) is a serious pest of paddy in many parts of India, especially in Madras, Mysore, Bombay,

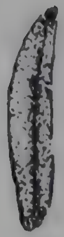

FIG. 1. Egg

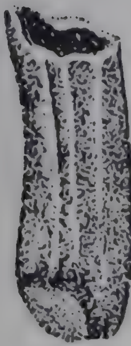

FIG. 2. Egg clusters

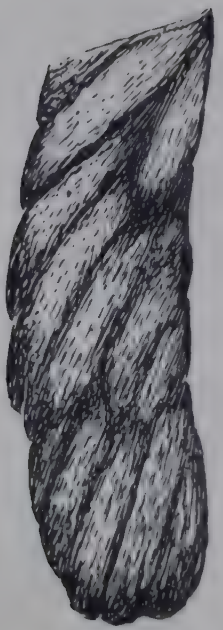

FIG. 3. Eggs in pod exposed

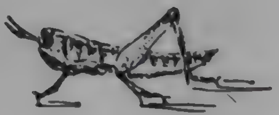

FIG. 4. Hopper—first stage

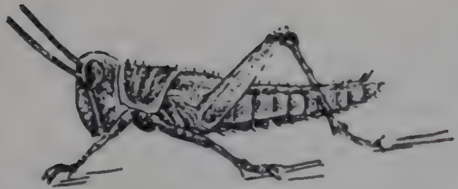

FIG. 5. Hopper—middle stage

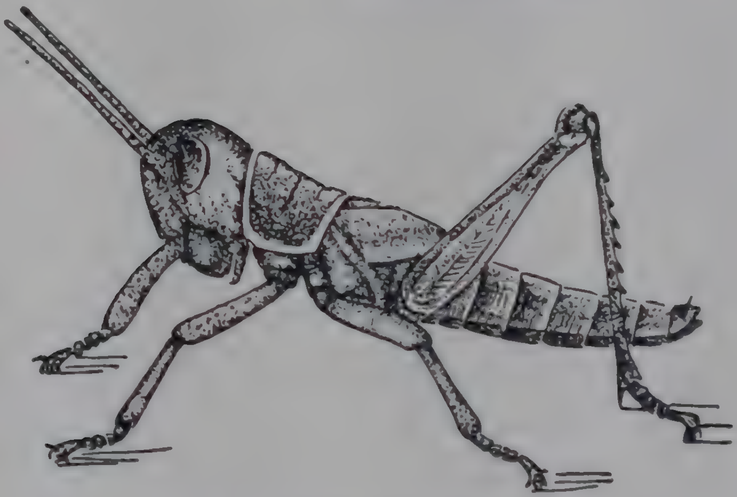

FIG. 6. Hopper—advanced stage

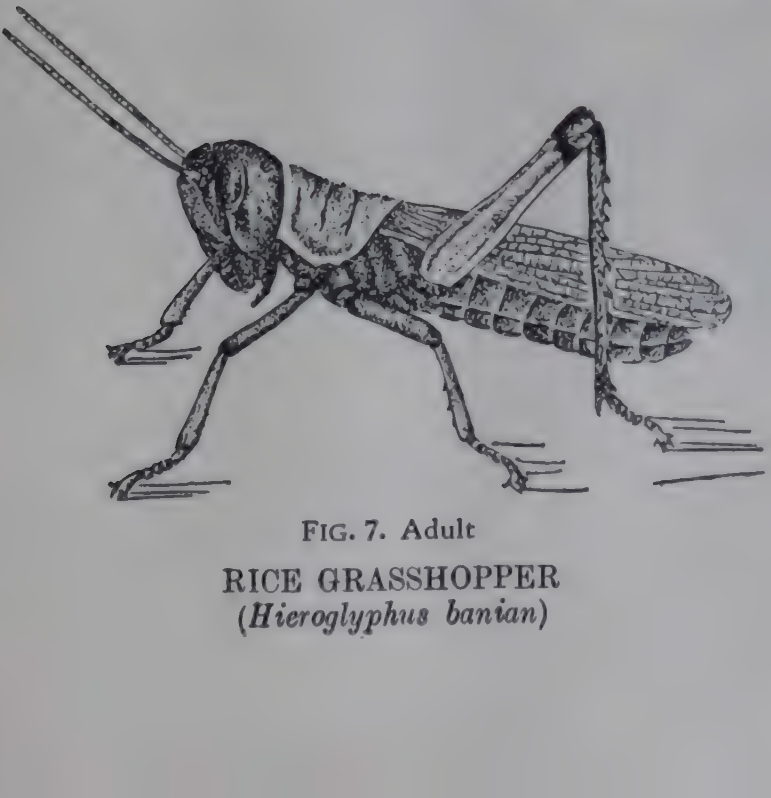

FIG. 7. Adult

RICE GRASSHOPPER
(*Hieroglyphus banian*)

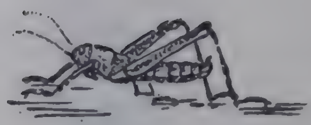

FIG. 8. Hopper—first stage

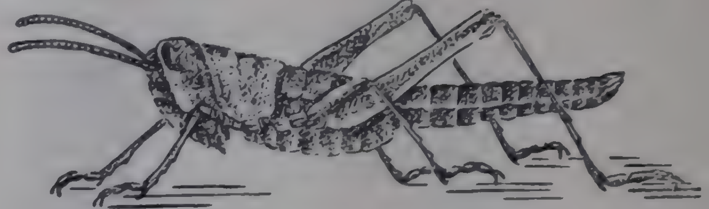

FIG. 9. Hopper—middle stage

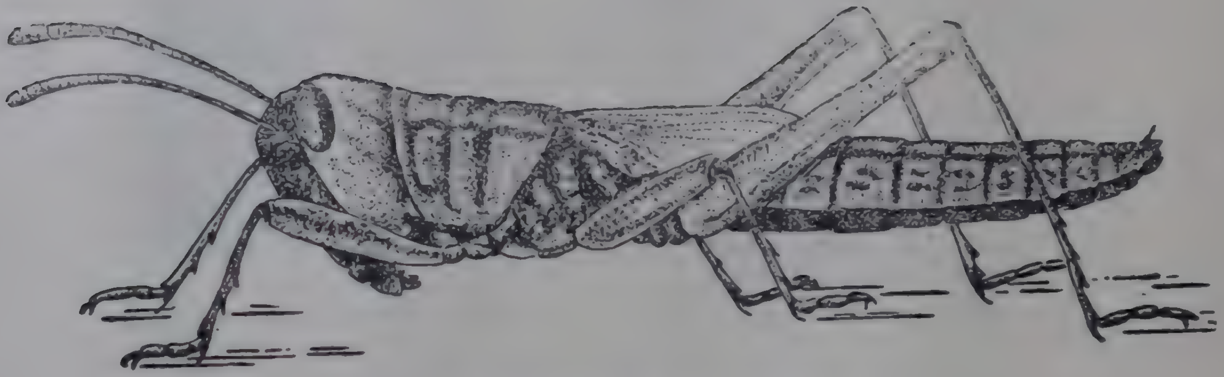

FIG. 10. Adult—male, short-winged

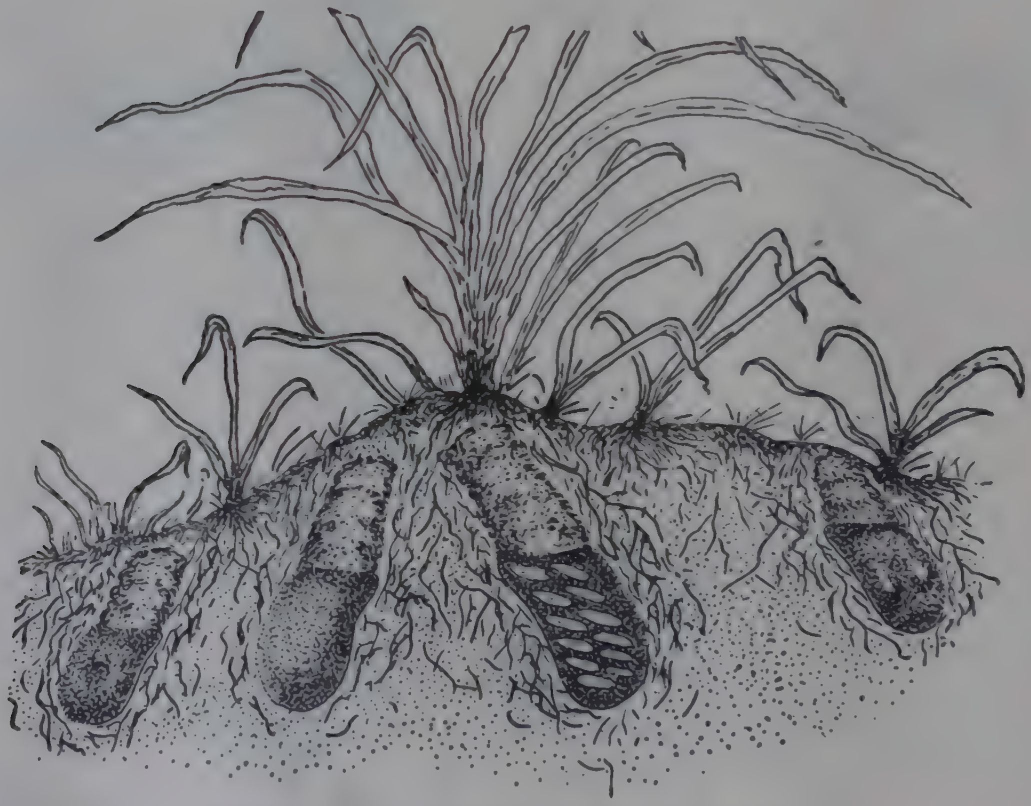

FIG. 11. Egg-pods laid at the base of bushes

PHADKA

(*H. nigrorepletus*)

the United Provinces, the Central Provinces and Orissa. Although paddy is its favourite food crop, it is known to attack sugarcane, maize, *jowar* and *bajra* also.

It is greenish in colour and is just over two inches long (Fig. 7). The male is smaller than the female. The egg clusters or pods (Fig. 2) are laid mostly along the field bunds. They are very tough and firm and are admirably suited for the long period of hard conditions through which the eggs remain viable till the following monsoon. The egg is yellowish in colour, slightly curved and about 5 mm. long (Fig. 1).

There is considerable variation in the time of hatching, depending on rains in different provinces. The earliest hatching is about the middle of June and the latest in first week of August. On emergence, the grasshopper is almost white in colour, which however, gradually changes into dark yellowish brown (Fig. 1). To reach the adult (winged) stage, the Rice-grasshopper has to pass through six or seven stages (Figs. 4, 5, 6) of various durations, the hoppers becoming adult and acquiring wings in two to three months.

By the beginning of October a fair number becomes adult and in November practically no hoppers are to be found. The adults are fully winged (Fig. 7) but they are poor fliers. Consequently the eggs are generally laid in the bunds of the area in which they had been feeding during the summer and monsoon season.

Phadka *Hieroglyphus nigrorepletus*

Unlike the Rice-grasshopper, *Phadka* prospers in drier areas and occurs in Bombay and Madras Provinces, the Central Provinces, Bihar, the United Provinces, Ajmer-Merwara and the adjoining States. It lives on grasses in general and is a pest of maize, *jowar* and *bajra* in particular. It has gained notoriety as a pest only in recent years, having been observed as such in Nellore (Madras) in 1937, in Sind (near Karachi) in 1940 and since 1946 it has come into prominence and progressively been causing extensive damage to the *kharif* crops in Ajmer-Merwara and lately in Udaipur, Kishangarh and Jodhpur Divisions of Rajasthan.

In its early stages *Phadka* feeds on the grasses growing on the field bunds, etc. Later, when the crop comes up, it moves to crops in the fields. When the crop is still young the hoppers feed vigorously on the leaves but as the ears are developed they prefer the tender juicy grains in them. They also get into and live in the leaf whorls. There their faecal matter accumulates, rots and creates a condition congenial for fungal growth. The plant becomes distasteful to the cattle and is lost to cultivators even as fodder.

As in the case of the Rice-grasshopper, *Phadka* passes the winter and pre-monsoon period in the egg stage. As a rule, the field proper is avoided for egg-laying and the female lays eggs on the sides of the bunds and other patches of raised ground (Fig. 11) such as exist around the bushes and the trees. The egg pods are more tough than those of the Rice-grasshopper.

After a good shower of rain in the month of July, the emergence of hoppers (Fig. 8) continues for about a month and they begin to attain the adult stage early in September. Barring a very small percentage, the adults are short-winged (Fig. 10). These dwarfed wings are only helpful to the insect in long jumps rather than actual flight. The pest therefore occurs year by year in the same locality which affords an opportunity for a pre-planned concentrated action such as is not possible in the case of the pests which have a migratory habit or are active fliers.

The Deccan Wingless-grasshopper

This grasshopper (*Colemania phenaroides*) differs from others in having wings reduced to small pads. Like *Phadka* it is common in areas having low rainfall. It is reported as pest mainly in the Deccan upland areas, and is found in Bombay Province from Ahmednagar down to Dharwar, in Chittaldroog and Shimoga districts in Mysore, in Bellary and Kurnool districts of Madras and in the Western Deccan districts of Hyderabad. It feeds mainly on *jowar*, *bajra* and other small millets but sometimes also damages wheat and the flowers and pods of pulses and other legumes.

The wingless adult is marked in vivid blue, green and red and is 1·5 to 2 inches long, the male being markedly smaller than the female. The eggs are laid in pods in the autumn at a depth of two to three inches in the soil, most often among the roots at the base of *jowar* and *bajra* plants and of the bushes on the field bunds, etc. They remain in the soil till next June, when following the fall of first heavy shower of the monsoon they develop and hatch into small hoppers. These, after passing through five stages of growth (Figs. 12, 13, 14) become the adult when they have well-marked wing pads or rudiments only (Fig. 15).

Not infrequently the millet crop is attacked and devastated when only the first one or two leaves have appeared. If the infestation is heavy even a full-grown crop is completely defoliated and one only finds the mere mid-ribs of the leaves emerging from the stubbles. When the ear heads appear, the tender grain in them is the first to be eaten away by the pest.

Control of grasshoppers

Till recently the chief methods of control of various grasshoppers comprised of (a) destruction of the eggs by ploughing the egg-laid area or scraping of a few inches of the soil along with the egg-pods, (b) poison-baiting of the hoppers and the adults, and (c) trapping them in hopperdozers or tin sheets besmeared with a sticky substance, such as coal-tar. With the discovery of some synthetic insecticides, such as benzene hexachloride, during the last war, we have now methods more effective and suitable for large scale operation such as we need when the infestation is really extensive.

Baiting

Mixing of a poison with a suitable food material to serve as a bait for the hoppers or dusting a poison over the tender bodies of young hoppers for killing them are the two equally important methods. It is important to emphasize at once that the use of either of these methods is far more effective when the young grasshoppers are still concentrated along the bunds than after they have grown in size and are dispersed over the entire field. Fighting grasshoppers before they attack or at the time when they first invade crop is most essential for ensuring the success of the control operations. This is particularly true in the case of baiting operations which invariably should be restricted to the early stages when the pest is on the bunds or on the fringes of the crop. The composition of the bait to be effective against the pest and at the same time remaining practically harmless to human beings and the cattle is :

Bran	50 seers
Sodium fluosilicate	1 seer
Molasses or salt ...	1 seer
Water	as required

As to the preparation of the bait, bran and sodium fluosilicate should be mixed intimately in the dry state. Molasses or salt should be dissolved in a small quantity of water and mixed in the bran and poison mixture. The quantity of water to be added should be just enough to make the bait moist but not so wet as to form lumps.

In the case of the Rice-grasshopper and *Phadka* the use of the bait is possible only when the hoppers are yet young and concentrated on the bund or in the grass land. Once they concentrate in the field, bait is of little avail. In the case of the Rice-grasshopper the condition of the field (water or mud) makes baiting inside the field unpractical, and in the case of *Phadka* the bait spread out on the field remains untouched because the grasshoppers remain always on the plants themselves. However, in the case of Deccan Wingless grasshopper, since the pest first appears in the fields themselves when the crop is almost in the germinating stage, baiting is required and is practicable both in the field and around on the bunds, etc.

Dusting

Whereas baiting can only be adopted advantageously when the hoppers are yet young before they concentrate in the field, control by poison dusting is practicable throughout the season. Of course, it is economical and easier to deal with the pest in earlier stages.

A suitable dust such as chalk charged with benzene hexachloride (BHC) in the form of proprietary insecticides such as Gammexane, Hexyclan, etc. have been found to be very effective. These proprietary preparations differ from one another mainly in the composition of the carrier or base, the active agent or poison being the same. Therefore there is not much to choose between the two. However, the three grasshoppers under consideration are not affected by the poison equally. The Rice-grasshopper is more susceptible, and is easily killed by the dust containing five per cent benzene hexachloride. As regards the *Phadka* and the Deccan grasshopper, this strength is effective only in the very early hopper stages and when the hoppers are bigger the strength of BHC has to be increased to seven per cent. To be on the safe side, it will be useful to use seven per cent benzene hexachloride throughout the operation. The amount of

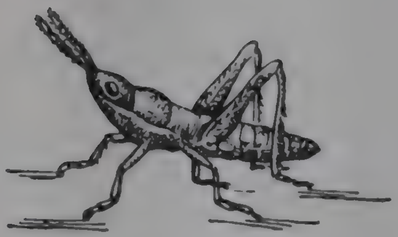

FIG. 12. Hopper—first stage.

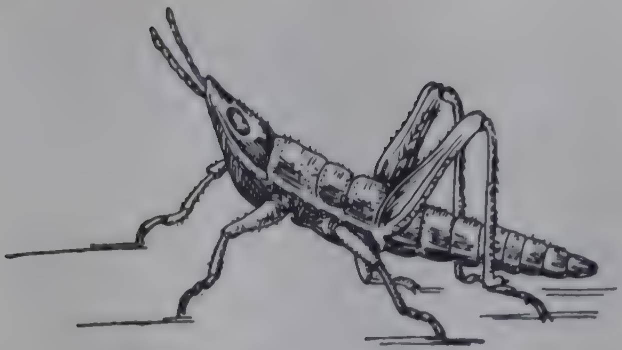

FIG. 13. Hopper—middle stage

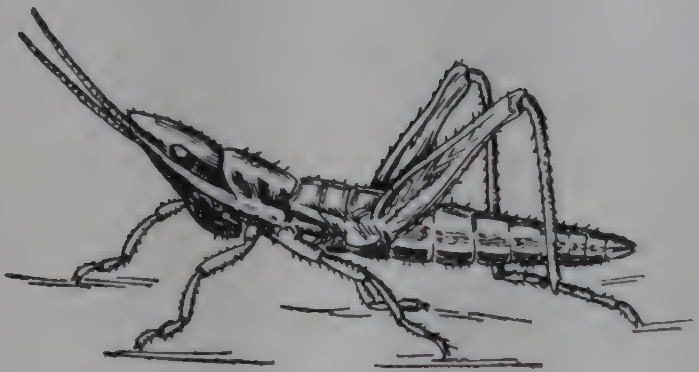

FIG. 14. Hopper—advanced stage

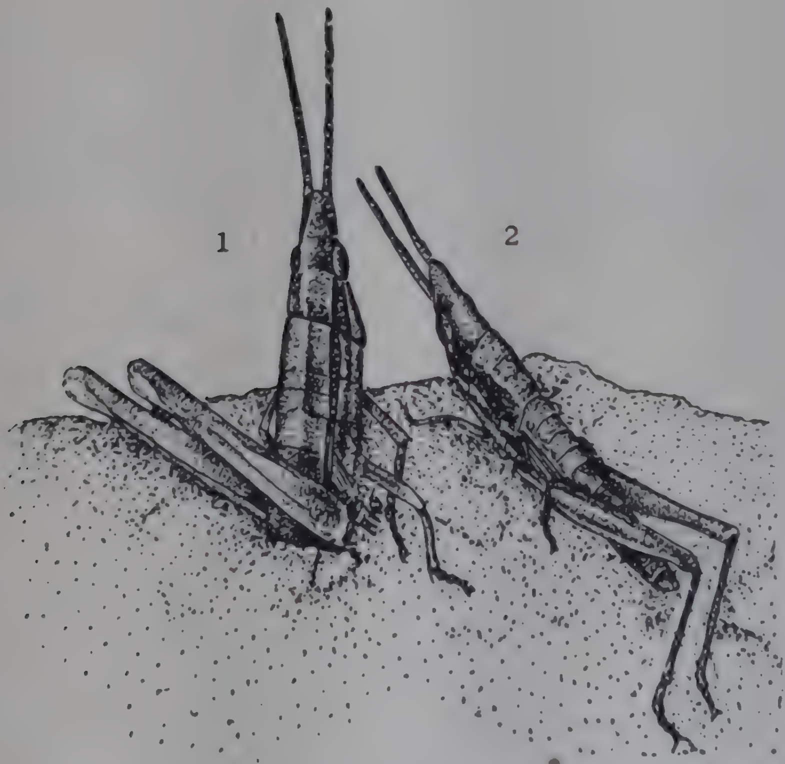

FIG. 15. (1) Female laying eggs
(2) Male

DECCAN WINGLESS
(*Colemania phenaroides*)

dust required per acre depends on the state of the crop. The more developed and dense is the crop the larger is the quantity of poison dust that will be needed. Thus the quantity of the poison dust required varies from 10 to 20 lb. per acre.

Grasshoppers do not die immediately after they have been dusted. The poison may require 10 to 18 hours to become fully effective. But that the poison is going to be effective can be seen even after an hour. It usually makes grasshoppers sick within that short period and so they stop feeding after having received a fatal share of the dust.

It should be emphasized that, contrary to a widespread impression, the crop is safe as cattle food after 36 hours of treatment.

A word regarding cooperation among the cultivators is necessary. When the breeding is isolated and the grasshoppers emerge on a particular field, the individual action on the part of the cultivator concerned may be sufficient. But during the period of the outbreak, the hoppers emerge in such numbers that they are likely to move from one farm to another. In such cases the village should be a unit and the individuals should look to the interest of the entire village. The whole area should be systematically dusted. It is to nobody's advantage to be selfish, for a single treated field in the midst of an infested area is bound to get infestation again.

RAILWAY LANDS FOR FOOD CROPS

IN view of the importance and urgency of the problem of food production, large plots of railway lands at present growing grass, are to be utilized for growing food crops. Subject to certain conditions, the Railway authorities are reported to be willing to lease these lands to Provincial Governments on the payment of a lump sum of money. The Central Ministry of Agriculture has requested the Railway Board to prepare a list of such railway lands and supply it to the Governments of the areas concerned.

Provincial and State Governments have also been asked to undertake surveys of such suitable plots, and negotiate for getting them on lease for a reasonable period. The practice in some provinces has been for the railway to auction the lands to a few contractors who in turn lease them out to the cultivators of the villages through which the railway passes.

PLANT INTRODUCTION REPORTER—I

By B. P. PAL and H. B. SINGH

THE importance of plant introduction and exploration is well known. It is as the result of introduction of new plants from one country to another that we now see such a wide variety of food, fodder and other economic plants in almost every country. It is a striking fact that until comparatively recent times the Eastern and the Western Hemispheres had few cultivated plants in common. In agriculturally advanced countries like the United States of America, plant introduction work is controlled by properly organized Bureaux of Plant Introduction and Exploration and immense benefits have resulted from the work of such Bureaux. Much of the improvement that has taken place in the crop varieties grown in the United States of America during the past 50 years or so, can probably be traced to the valuable contributions made by their efficient plant introduction service. To cite a few classical examples of successful plant introduction, mention may be made of the introduction of rubber to the Far East from the Amazon region, sugarcane from the East to the West Indies, potatoes from South America into Europe, cinchona from South America into the East Indies, and groundnuts from Brazil into Africa and India.

Plant exploration

The rapid advances in plant breeding techniques have resulted in the evolution of superior strains of crop plants and differentiation of ecotypes suitable for cultivation under a wide range of climatic conditions. The introduction of such materials from one country to another and their evaluation and utilization in breeding form one of the important methods of plant breeding. During the last two decades or so plant breeders and geneticists have come to realize that greater possibilities in breeding could be realized through the use of new and useful genes possessed by closely-related wild relations of cultivated plants. Therefore plant exploration forms an important function of plant introduction organization. The utilization of a wild species of *Saccharum* in the evolution of improved strains of sugarcane is an outstanding example of the utility of wild relations of crop plants. Potato breeding has been revolutionized by the discovery in South America of disease-resistant wild potatoes.

Plant introduction in India

In India plant introduction has been on the whole rather slow and haphazard. The Botanical Survey of India, the Royal Botanic Gardens, Sibpur, the Lloyd Botanic Garden, Darjeeling, and other bodies and individuals introduced some useful plant material, mostly however of non-agricultural importance. With the establishment of the Agriculture Departments in the early years of the twentieth century scattered attempts have been made by these departments for the introduction of plant material of agricultural importance.

The desirability of having an organization similar to the one in America or the U.S.S.R. was stressed by the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, which met in 1935. The need for such a Bureau for India was reiterated at the meeting of the Board of Agriculture in 1941 when the subject 'New Economic Crops' was discussed. In 1944 at the request of the Indian Council of Agricultural Research, the Division of Botany of the Indian Agricultural Research Institute submitted a small scheme for the establishment of a nucleus organization for the introduction of new economic plants pending the setting up of a full-fledged Bureau. This scheme was sanctioned for a period of five years from April, 1946.

Since the start of this small scheme efforts to import useful plant material particularly of agricultural importance from various countries have been continuing and satisfactory progress is being made. A limited amount of plant exploitation work has also been in progress,

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small areas within the country have been surveyed and useful plant material collected, studied and maintained as far as possible. As a result of this a collection of useful indigenous and exotic material has been built up seeds of some of which are available in limited quantities for trial and use by workers outside. A list of such material is given below. It is proposed to publish periodically lists of plant materials imported or collected from within the country indicating those of which seeds can be supplied. These lists are expected to be of value to plant breeders and others in this country concerned with crop plants, medicinal plants, soil-conservation plants, etc.

The introductions listed and in some cases briefly described in this report represent varieties and strains of cereals, pulses, oil-yielding plants, fibre-producing plants, fodder and forage grasses and legumes, plants useful for soil conservation, vegetables, medicinal plants and also wild relatives of cultivated plants. The list simply records the receipt of seeds of possible value and does not attempt to assess their usefulness for various purposes or for different areas; such work is however in hand and notes will be published from time to time as data become available. The names of species and varieties mentioned are those under which the seeds are received. Not all of these have been finally checked for their botanical identity. The indigenous plants have been listed separately in this catalogue. The plants of which small quantities of seeds or other planting materials are immediately available for distribution have been indicated by an asterisk mark. The double asterisk mark indicates that the material has been sent to provinces for trial. 'E.C.' numbers refer to accession numbers for the exotic collection.

Illustrations of some of the plants grown in the plant introduction plots at Delhi have also been incorporated.

Acknowledgment

The writers are indebted to Dr J. N. Mukherjee, Director of the Institute, for his great interest and encouragement in the project and the useful suggestions he has made from time to time.

Exotic collections

Cereals

Wheat (*Triticum vulgare*) (Gramineae)

E.C. 257-261 : Celebration, Charter, Gabo, Kendee, Yalta. From Temora Experimental Farm, Sydney, Australia.

E.C. 313-317 : Plantakof, Nostrano, MC 245, 56/96, Huron. From Swiss Experiment Station for Agriculture, Sweden.

E.C. 346 : Diadem; Department of Agriculture, Victoria, Australia.

E.C. 347 : Gabo, Sydney University, Australia.

E.C. 366-374 : Warigo, Hofed, Fedweb, Gabo, Ridley, Javelin, Bencubbin, Seewari, Ranee. Waite Agricultural Research Institute, Adelaide, South Australia.

E.C. 375-407 : Recent rust-resistant selections. From Senior Plant Breeder, Kenya.

E.C. 408-412 : Shinchunaga, Norin No. 4, Norin 52, Igachikago, Saidamakomugi 27. From Japan, through the Indian Council of Agricultural Research.

E.C. 414-439 : Selections from various complex crosses for rust resistance. From Mr. Mcfadden, U.S.A., through S. Labh Singh, Director of Agriculture, Jaipur.

E.C. 464 and 465 : N. 150, Hy 423, I5, CCC. Senior Agricultural Botanist, Government Farm, Acre, Palestine.

E.C. 472 : Saunders. Central Experimental Farm, Ottawa, Canada.

E.C. 473-477 : Charter, Yalta, Celebration, Kendee. Sydney University, Australia.

E.C. 507-511 : From Taiwan Agricultural Research Institute, Taiwan, Formosa.

E.C. 574-646 : From Argentina. Through Mr. S. Percy Lancaster, Secretary, The Agri-Horticulture Society of India, Calcutta.

C.E. 715 : Cascade. From Canada.

E.C. 729** : A drought-resistant variety from Kabul. Through the Indian Council of Agricultural Research.

E.C. 730-735 : Mida, Cadet, Thatcher, Pilot, Pawnee, Comanche. From United States Department of Agriculture, through Dr Taylor of the American Embassy, New Delhi.

E.C. 796-803 and E.C. 835-838 : Rust-resistant wheats from U.S.A. through Mr. Boshi Sen, Almora.

E.C. 843-848: Coronation, Floreana, Trintecindo, Florestana, Kenia No. 2, Rio Negro. From Institute of Agronomy, Brazil.

Triticum spelta

E.C. 318 and 319 : Winter and summer varieties respectively. From Swiss Experiment Station for Agriculture, Zürich.

Barley (*Hordeum vulgare*)

E.C. 262-270 : Coast, Bolivia, Weider, Chevron, Iredell, Wintex, Barbless. From U.S.A.

E.C. 273, 284 and 279-284: Chevron, Lico, Brandon, Mars, Peatland, C.I. 1111, Kindred, Olson M41—1522. From Colorado and Minnesota Agricultural Experiment Stations, U.S.A.

E.C. 275-278: High malting barleys from Saskatchewan, Canada.

E.C. 294 and 295: Glacier, Compana. From Montana Agricultural Experiment Station, U.S.A.

E.C. 345: Maltworthy. From Agricultural College, Roseworthy, South Australia.

E.C. 468-471: From Government Farm, Acre, Palestine.

E.C. 512-513: Tainang Native, Tainang No. 2. From Agricultural Research Institute, Taiwan, Formosa.

E.C. 815-834: B.6 (Virginia hooded), B.10, B.13, B.17, B.19, B.30, B.31, B.42 (Manchuria Selection), B.46 (Cape), B.49 (Kinwar), B.55 (Golden Grain), Princess, Gold Thorpe, Tunis, Gatama, Roseworthy Oregon, Squarehead, Cape. From Sydney University, Australia.

Oat (*Avena* spp.)

E.C. 514-516: From Taiwan Agricultural Research Institute, Formosa.

E.C. 736-740: Pama, Fulton, Boone, Mapion, Control. From U.S.A., through Dr Taylor of the American Embassy, New Delhi.

Rice (*Oryza sativa*)

E.C. 312**: New kind. From Russia received through the Indian Council of Agricultural Research. Said to be suitable for growing on steep lands.

E.C. 497-506**: From Taiwan Agricultural Research Institute, Formosa.

Maize (*Zea mays*)

A number of commercial varieties, inbreds and single and double crosses from U.S.A., South Africa, and Australia. These form part of the material of the scheme for the improvement of maize crop in India working, at the Indian Agricultural Research Institute, New Delhi.

Pulses

Soybean (*Glycine max*) (Papilionaceae)

E.C. 324-331: Green, yellow, brown, black and variegated varieties. From China.

E.C. 440: From Director of Plant Industry, Philippines.

E.C. 745* and 746*: Earlyana and Lincoln. From U.S.A., through Dr Taylor, American Embassy, New Delhi.

Indian vetch (*khesari*) (*Lathyrus sativus*) (Papilionaceae)

E.C. 4* and 5*: White-seeded, brown-seeded. Large bold seeds rather late maturing. From Australia, through Dr W. Burns formerly Agricultural Commissioner with the Government of India.

E.C. 413*: From Iran. Probably wild. Received for seed identification.

Peas (*Pisum sativum*) (Papilionaceae)

E.C. 442*: Chinese. From Director of Plant Industry, Philippines.

E.C. 794*: Notts Excelsior. Harvey Seed Co., New York.

Green gram (*mung*) (*Phaseolus aureus*) (Papilionaceae)

E.C. 443: Native. From Director of Plant Industry, Philippines.

Phaseolus calcaratus

E.C. 776: From Economic Botanist, Burma.

Oil-yielding plant

Linseed (*Linum usitatissimum*) (Linaceae)

E.C. 519-573: 54 varieties from Argentina. Received through Mr. S. Percy Lancaster, Secretary, The Agri-Horticultural Society of India, Calcutta.

Flax (*Linum usitatissimum*)

E.C. 256*: Wada. From Western Australia. Rust-resistant.

Safflower (*Carthamus tinctorius*) (Compositae)

E.C. 647-653: Seven selections from Research Agronomist, Nebraska, U.S.A.

Castor (*Ricinus communis*) (Euphorbiaceae)

E.C. 285-286**: Two varieties from Italy. Received through Dr P. S. Hudson, Director, Commonwealth Agricultural Bureau.

Sunflower (*Helianthus annuus*) (Compositae)

E.C. 722*: Short Early Russian. From Montana Agricultural Experiment Station, U.S.A.

E.C. 812-814**: High oil-yielding varieties from Australia brought by S. Datar Singh, Vice-Chairman, Indian Council of Agricultural Research.

E.C. 883-886: Jupiter, Russian, Mars, Pole Star. From College of Agriculture, Potchefstroom, South Africa.

Fibre-yielding plants

Cotton (*Gossypium* spp.) (Malvaceae)

E.C. 450-452: White Native, Kapas Purao Native, Ferguson (U.S.A.). From Director of Plant Industry, Philippines.

China jute (*Abutilon avicennae*) (Malvaceae)

E.C. 320*-321 : From China.

Aramina (*Urena lobata*) (Malvaceae)

E.C. 849 : Guaxima. Instituto Agronomico Seccao De Introducao De Plantas Compainas S. Paulo, Brazil.

Phormium (*Phormium tenax*)

E.C. 779 : From Auckland University, New Zealand.

Narcotics

Tobacco (*Nicotiana tabacum*) (Solanaceae)

E.C. 459-461 : Gold Dollar, Cash, Simnata. From Director of Plant Industry, Philippines.

E.C. 743-744 : Shade wrapper, Conn. 15. From U.S.A., through Dr Taylor of American Embassy, New Delhi.

Vegetables and root crops

Chinese cabbage (*Brassica chinensis*) (Crucifereae)

E.C. 289* : Chihli. From Philadelphia, through Mr. Dickson, American Embassy, New Delhi. A useful leafy vegetable giving high yield of tender leaves throughout winter. Fig. 2 shows a crop grown in the Division of Botany, Indian Agricultural Research Institute.

E.C. 163* : Petsai. From China. Like the above in growth but characterized by dark green rather thick leaves with thick midribs.

Spinach (*Spinacia oleracea*) (Chenopodiaceae)

E.C. 183* : A prickly-seeded variety. From China. Produces leaves of excellent cooking quality.

Radish (*Raphanus sativus*) (Crucifereae)

E.C. 171*-173* and E.C. 351*-358* : From China. Early and late varieties. Round or oblong shapes. Roots of one of the varieties E.C. 351A are pinkish from inside, these are less pungent and good flavoured.

Onion (*Allium cepa*) (Liliaceae)

E.C. 441* : Bermuda Yellow. From Director of Plant Industry, Philippines. Produces non-pungent bulbs of average size.

Malva crispa (Malvaceae)

E.C. 197* : From China. Appears worth trying as a new culinary herb.

Beans (Papilionaceae)

Yam bean (*Pachyrrhizus erosus*)

E.C. 340* : From China.

Goa bean (*Psophocarpus tetragonolobus*)

E.C. 456 : From the Director of Plant Industry, Philippines.

Lima bean (*Phaseolus lunatus*)

E.C. 775 : From Economic Botanist, Burma.

E.C. 760* : Fordhook. From U.S.A., through Mr. Boshi Sen, Almora. Appears to be suitable for Delhi conditions.

French bean (*Phaseolus vulgaris*)

E.C. 761 : Rival bush bean. From U.S.A., through Mr. Boshi Sen, Almora.

Sword bean (*Canavalia ensiformis*)

E.C. 333*: A bush variety from China.

Tomato (*Lycopersicon esculentum*) (Solanaceae)

E.C. 251*: Turrialba. From Costa Rica, through Dr B. B. Mundkur, formerly Second Mycologist, Indian Agricultural Research Institute.

E.C. 287 *: Rutgers. From Philadelphia, through Mr. Dickson, American Embassy, New Delhi.

E.C. 447*-449* : Native, Pearson, Marglobe. From Director, Plant Industry, Philippines.

E.C. 842 : Morden. Agricultural Experiment Station, Morden, Canada.

E.C. 788 : Ponderosa. Harvey Seed Co., New York.

Okra (*bhendi*) (*Hibiscus esculentus*) (Malvaceae)

E.C. 759 : Green Velvet. From U.S.A., through Mr. Boshi Sen, Almora. A variety without ridges on the fruit which does not dehisce on maturity.

E.C. 784-787 : Crimson Spineless, Louisiana Spineless Velvet, Hastings Dwarf Green, Perkins Mammoth. From South Carolina, U.S.A.

Sweet potato (*Ipomoea batatus*) (Convolvulaceae)

E.C. 712-714 : F.A. No. 17, F.A. No. 31, Native Tei Shin-Tun. From Taiwan Agricultural Research Institute, Taiwan, Formosa. The last-mentioned variety did well at Delhi (Fig. 4).

E.C. 764-771 : Big Stem Jersey, Triumph, Ranger, B-219, F.B. 4004, Pelican Processor, B. 4306, Unit 1, Puerto Rico. From U.S.A., through Mr. Boshi Sen, Almora. Varieties B-219, Pelican Processor and B. 4306 did well at Delhi.

E.C. 905-917 : 13 varieties from South Africa (Division of Horticulture, Pretoria).

Sponge gourd (*Luffa cylindrica*) (Cucurbitaceae)

E.C. 178*: White-seeded and large-fruited variety from China.

Fodder and forage grasses

Giant Star grasses

E.C. 1* : *Cynodon plectostachyum*. Seeds obtained from the Royal Botanic Garden, Kew. Pasture and hay, also for soil conservation.

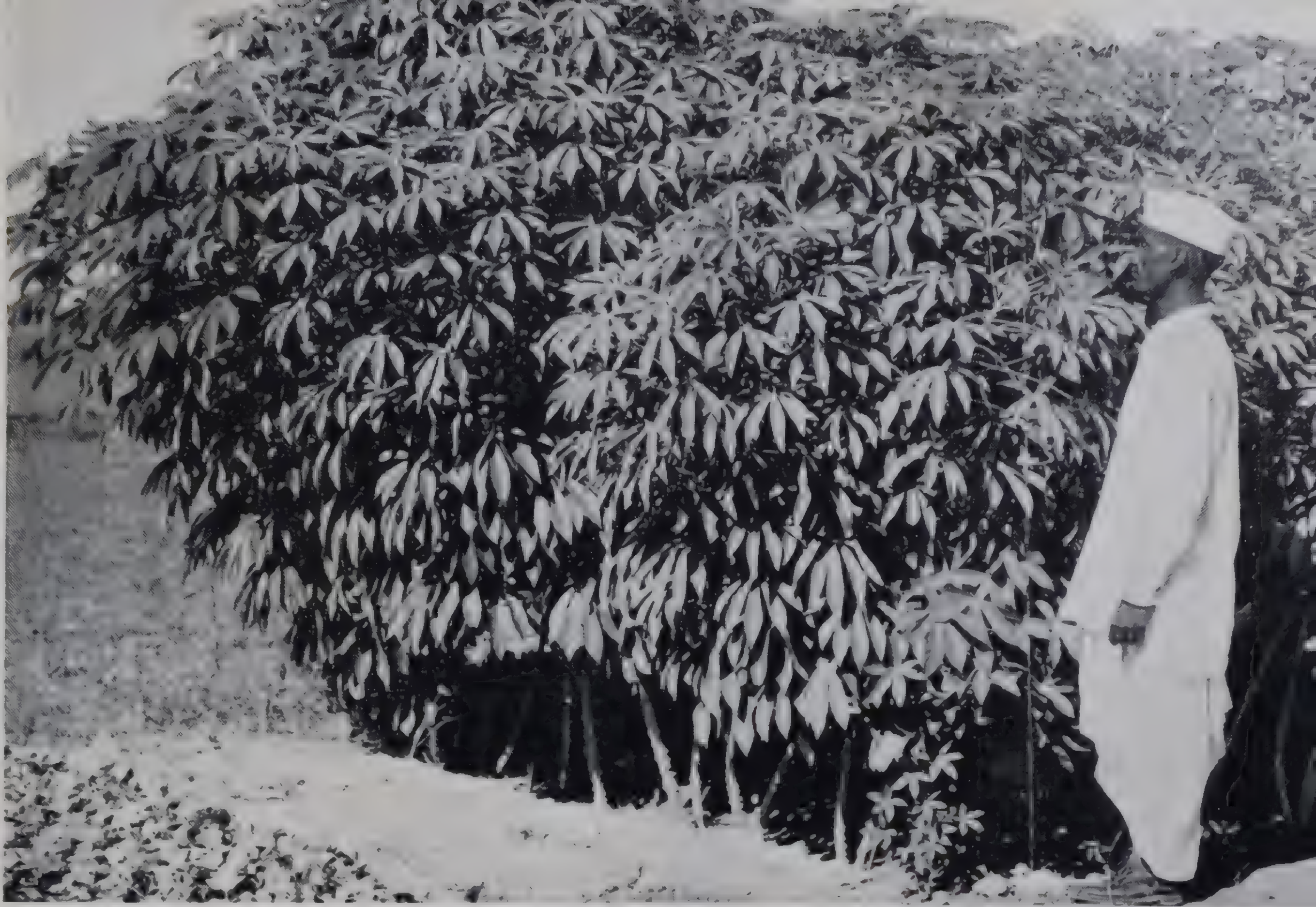
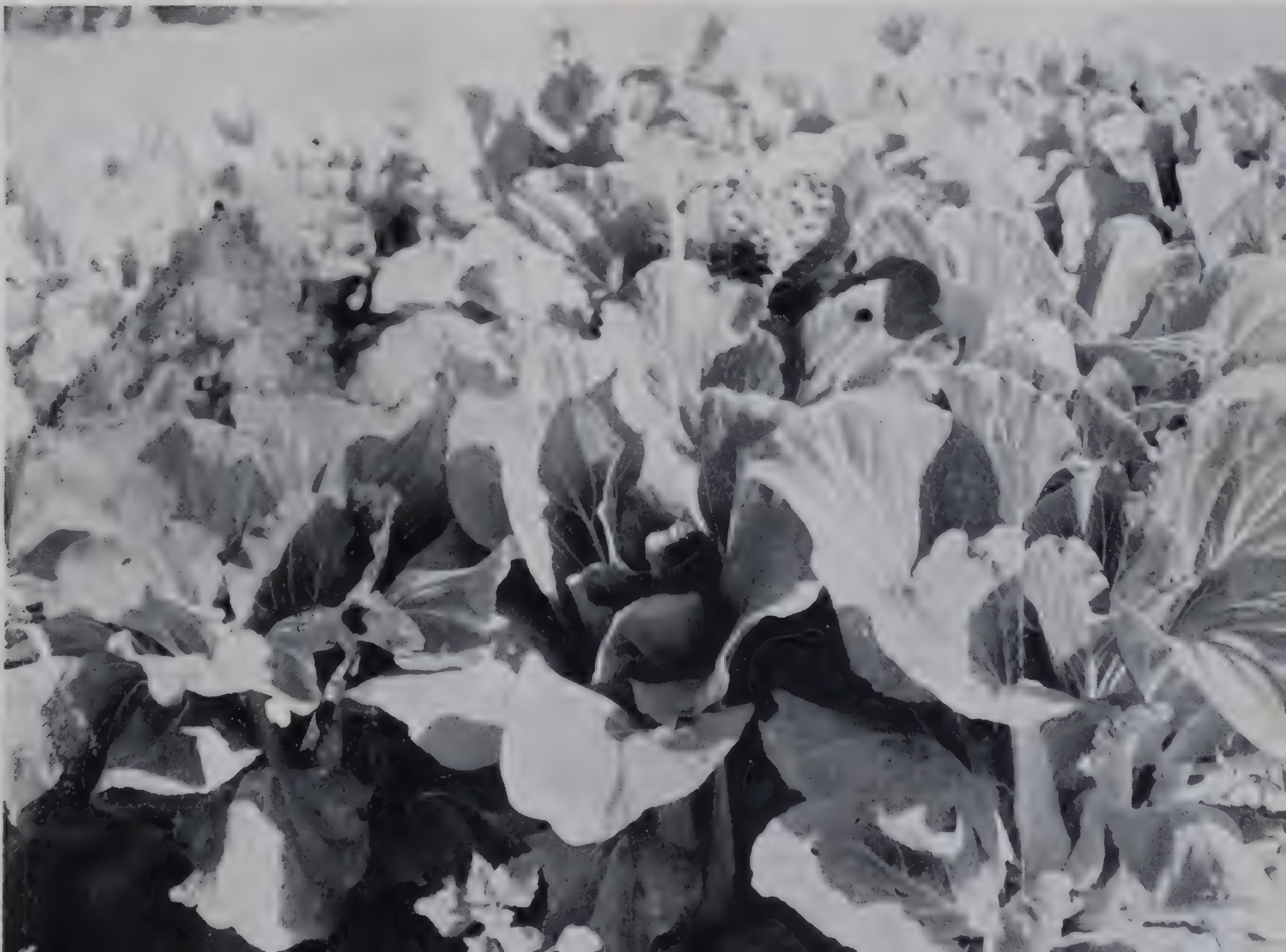


FIG. 1 (Above). Tapioca (*Manihot utilissima*)—the valued root crop of west coast districts. Seven months old plants of Travancore varieties grown at Delhi

FIG. 2 (Below). A view of the crop of Chinese cabbage (*Brassica chinensis*). A useful leafy vegetable giving high yield of tender leaves



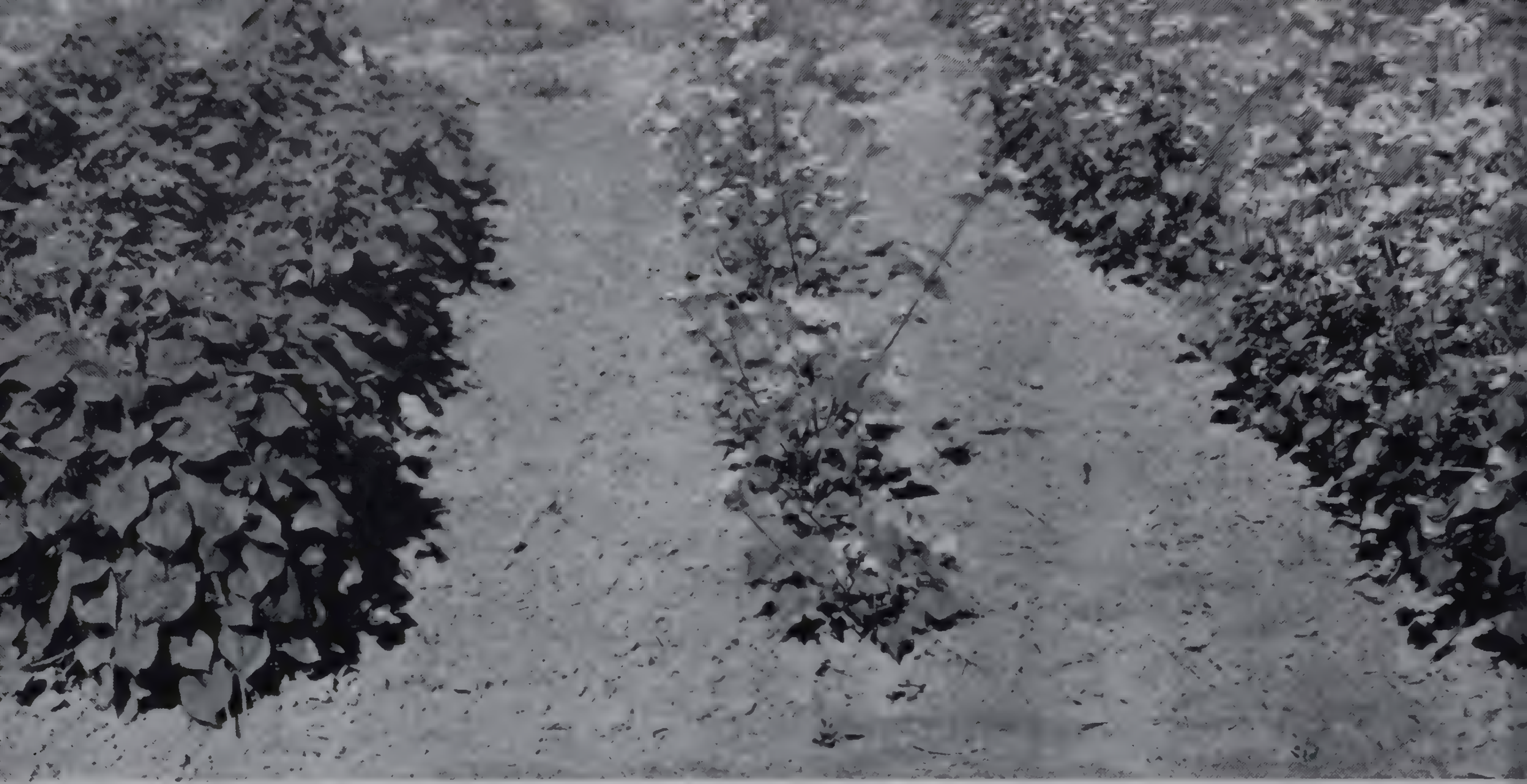


FIG. 3. Buckwheat (*Fagopyrum esculentum*). On the left is the Darjeeling variety (late) and on the right are Chinese varieties which are early maturing

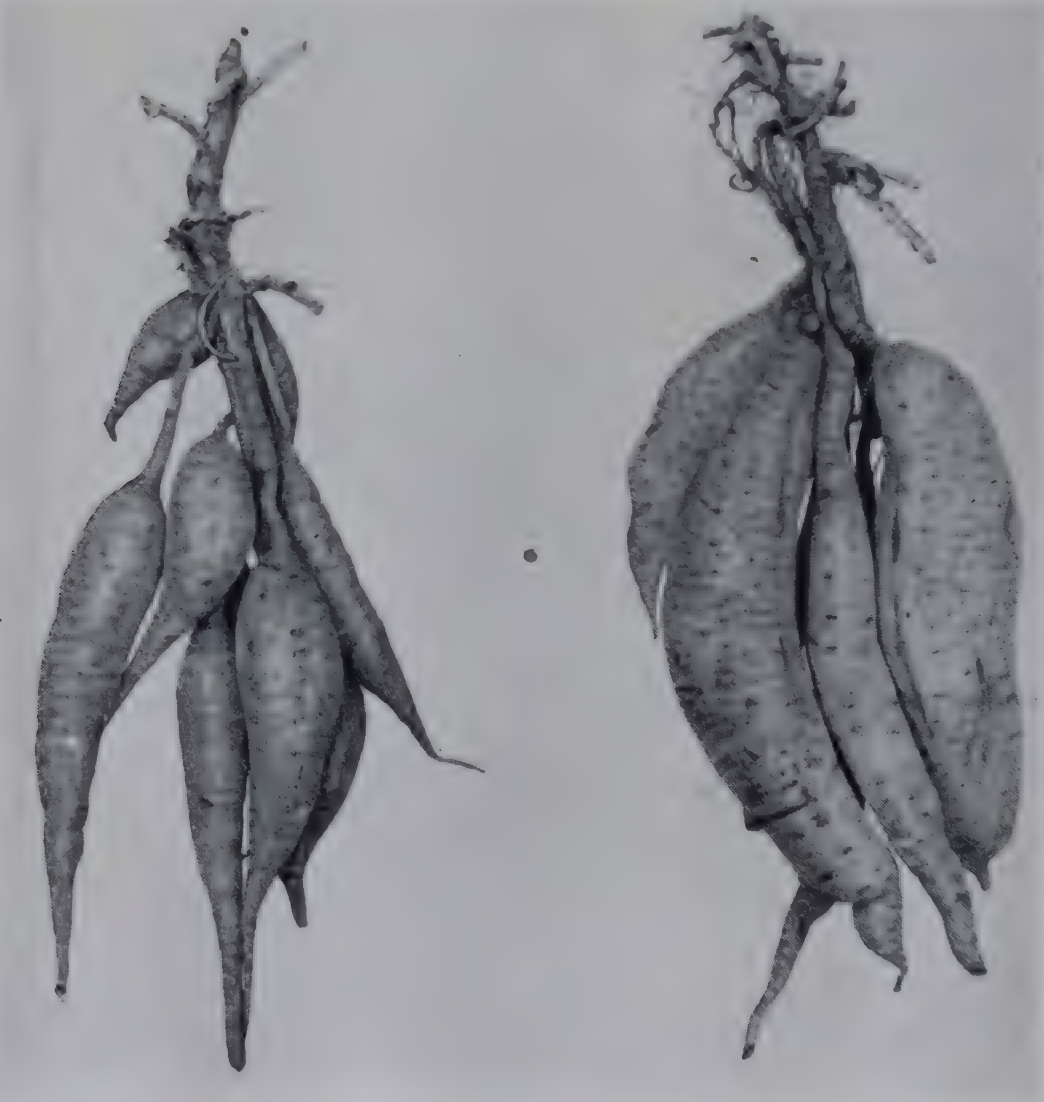
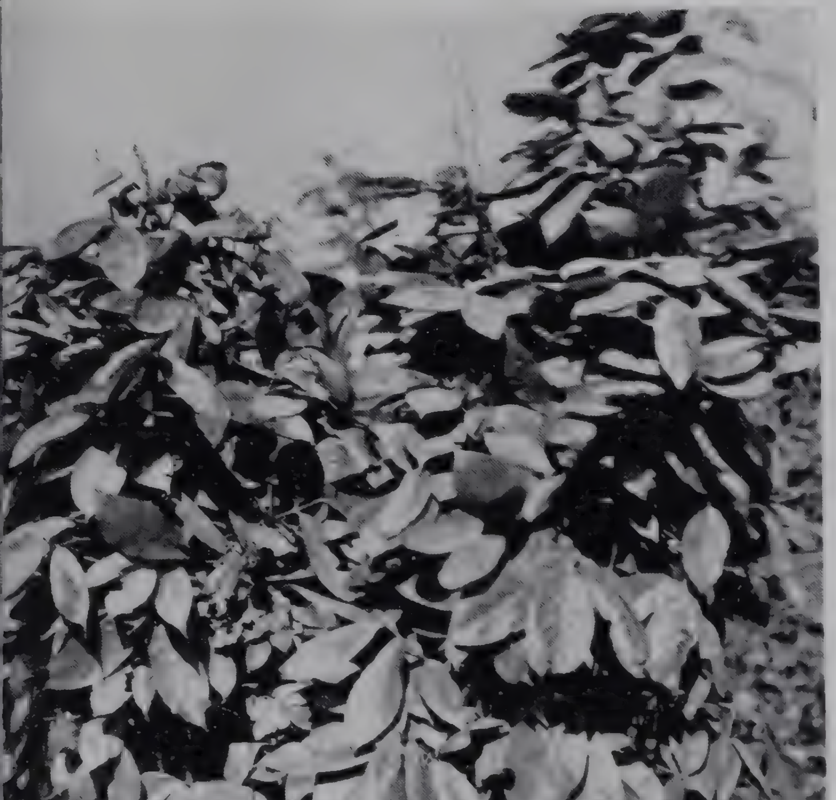


FIG. 4. Tubers of the Taiwan (Formosa) varieties which produced thick uniform roots in clusters



G. 5. Tuba Root (*Derris malaccensis*). Three-year old plants raised from stem cuttings rooted at Delhi. Roots contain rotenone—an insecticidal material

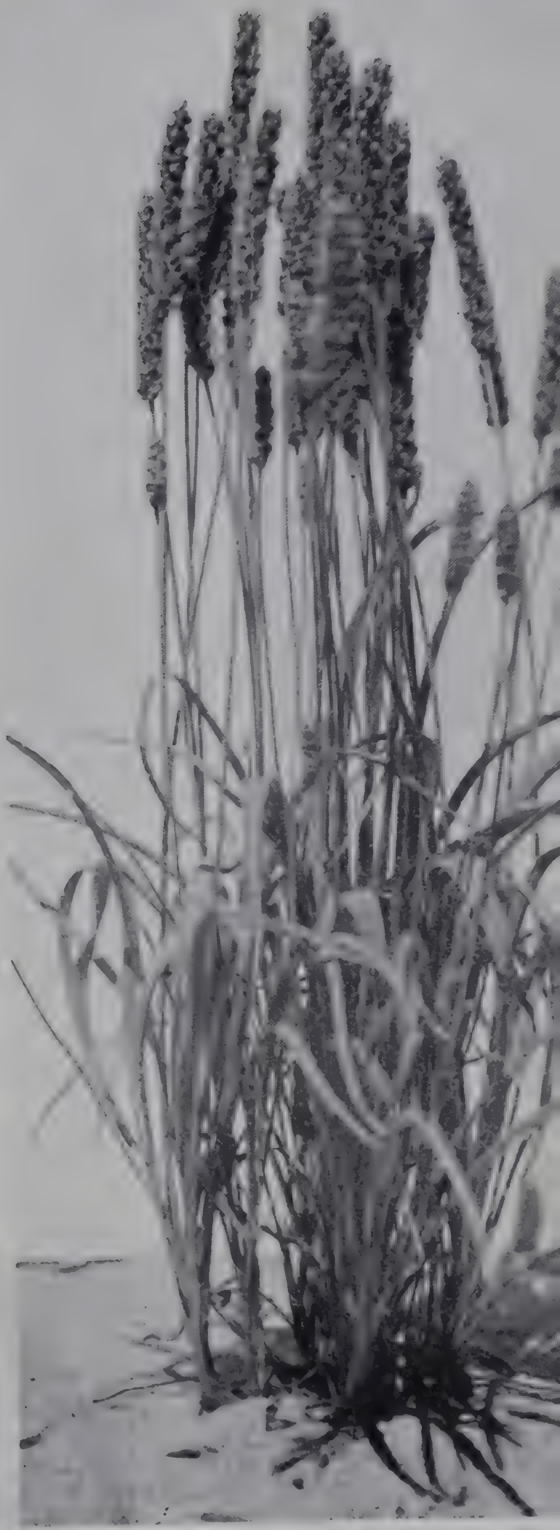


FIG. 6. *Isaphgul* (*Plantago ovata*). A solit plant in the mature stage. Se are medicinal

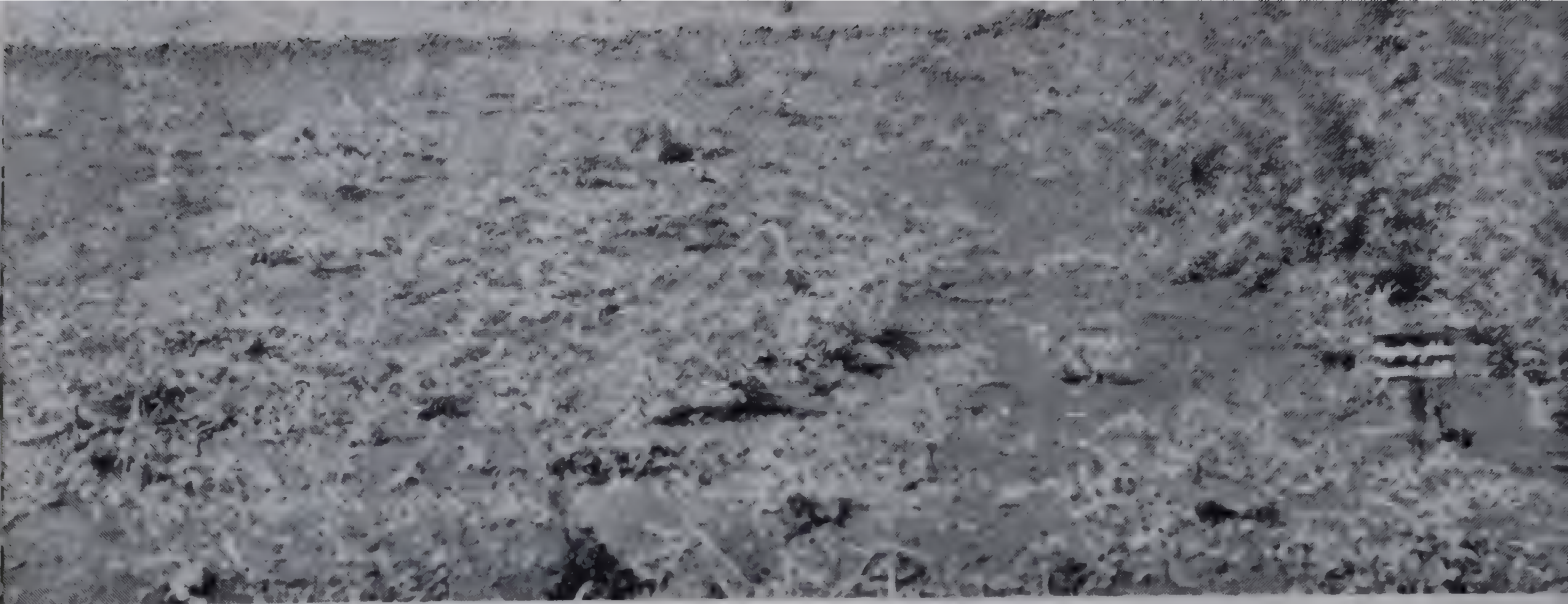


FIG. 8. Licorice (*Glycyrrhiza glabra*). On the left of the label are plants from the original planting while the scattered growths on the right are those from the stolons spreading underground

7. Psyllium (*Plantago psyllium*). A solitary plant in full bloom. Seeds are medicinal

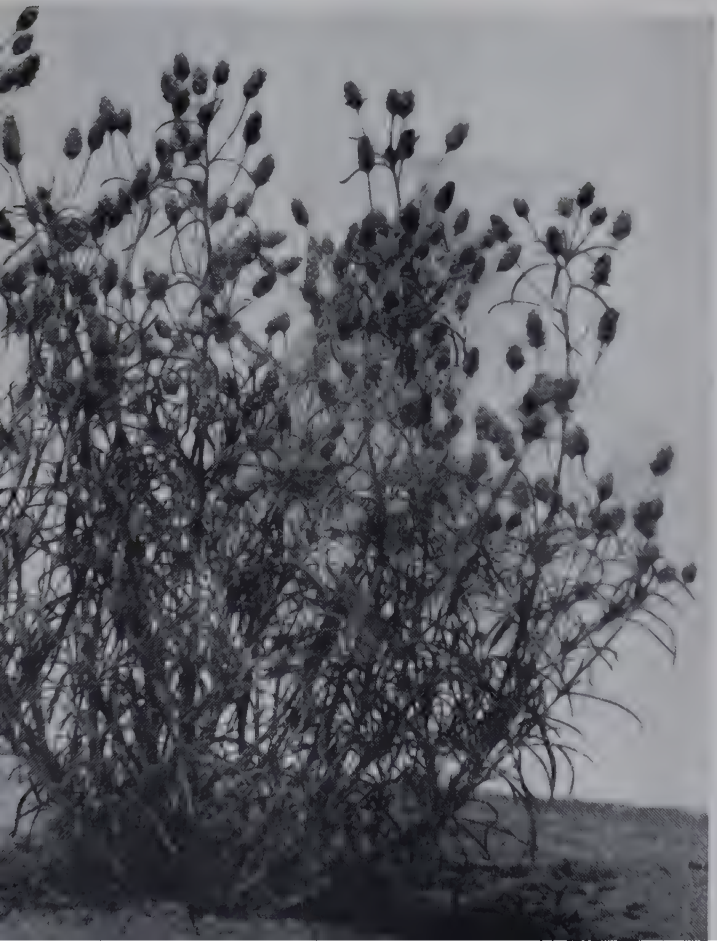
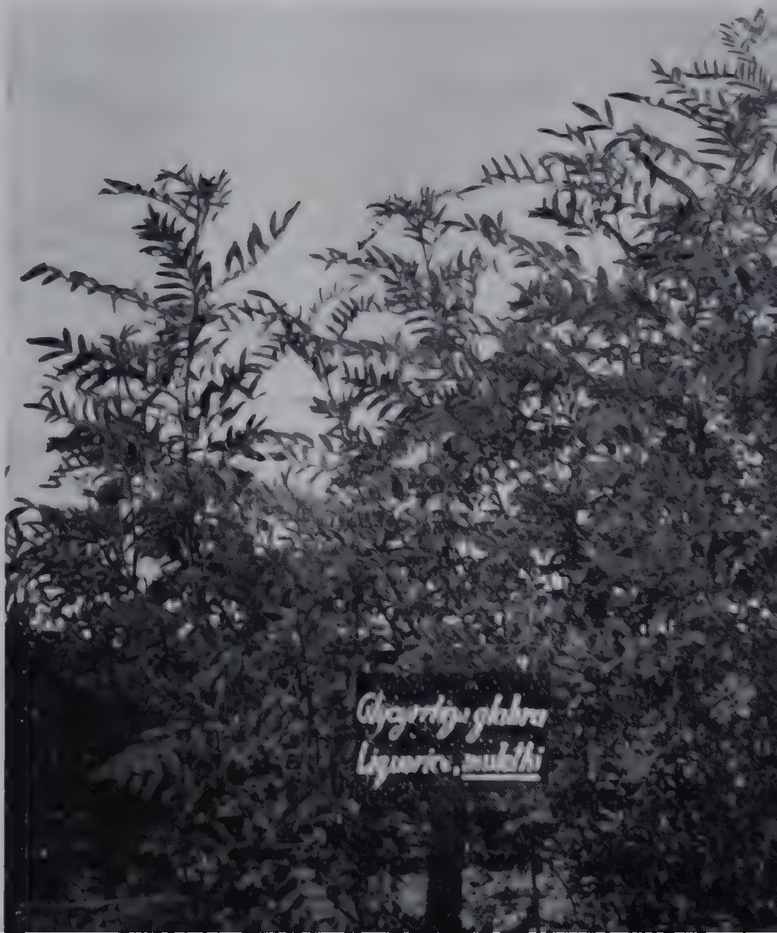


FIG. 9. A close view of the licorice plants before the ons of cold weather



Glycyrrhiza glabra
Liquorice. mulethi

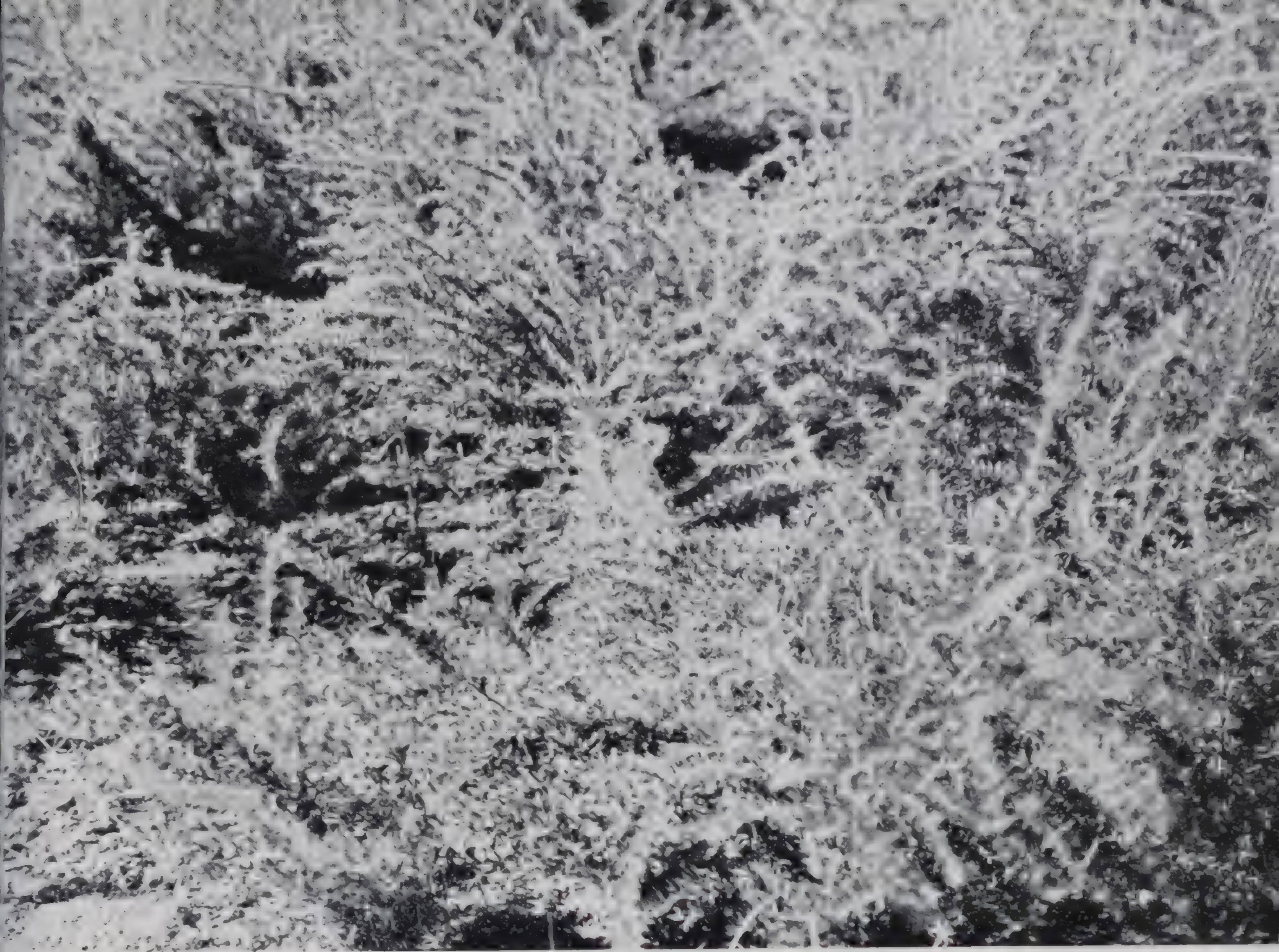
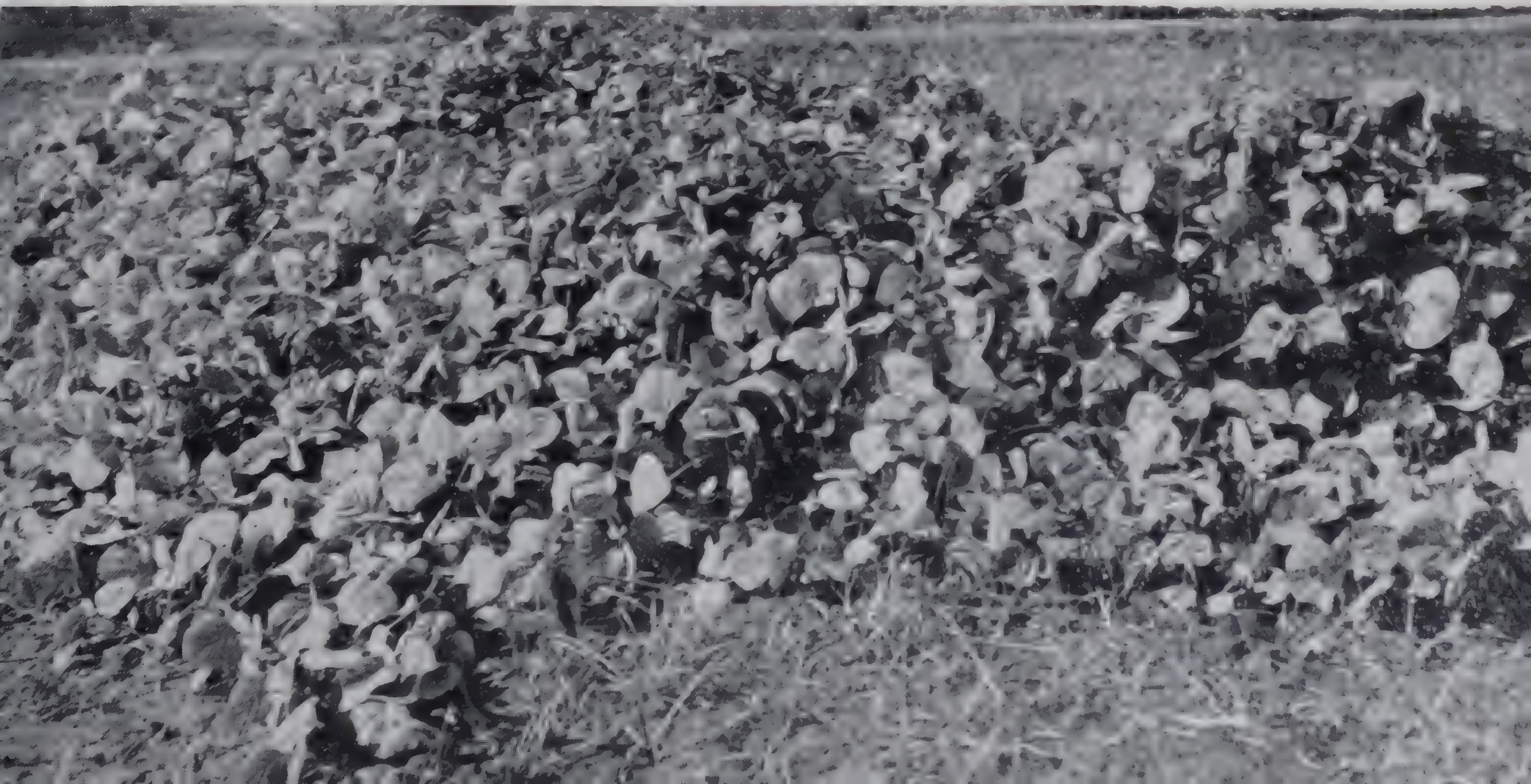


FIG. 10 (Above). A view of the crop of *Lespedeza cuneata* at the close of rainy season, showing vigorous growth. Flowers and fruits freely

PLATE 61

FIG. 11 (Below). Third year growth of the tropical kudzu (*Pueraria Phaseoloides*)



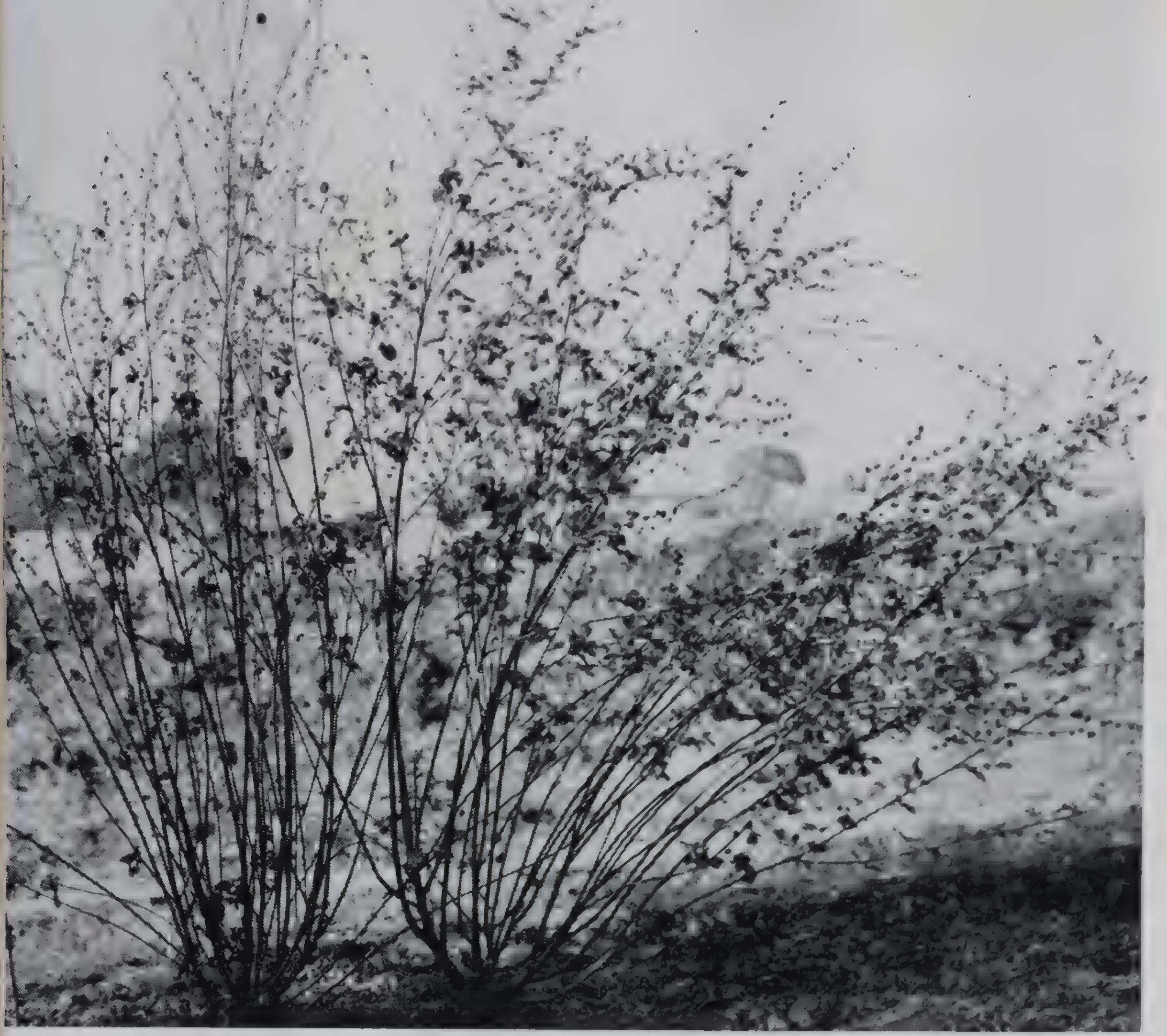


FIG. 12. The indigenous wild variety of Aramina (*Urena lobata*)—an important fibre plant of latin America, grown at Delhi. Produces fibre of good quality.

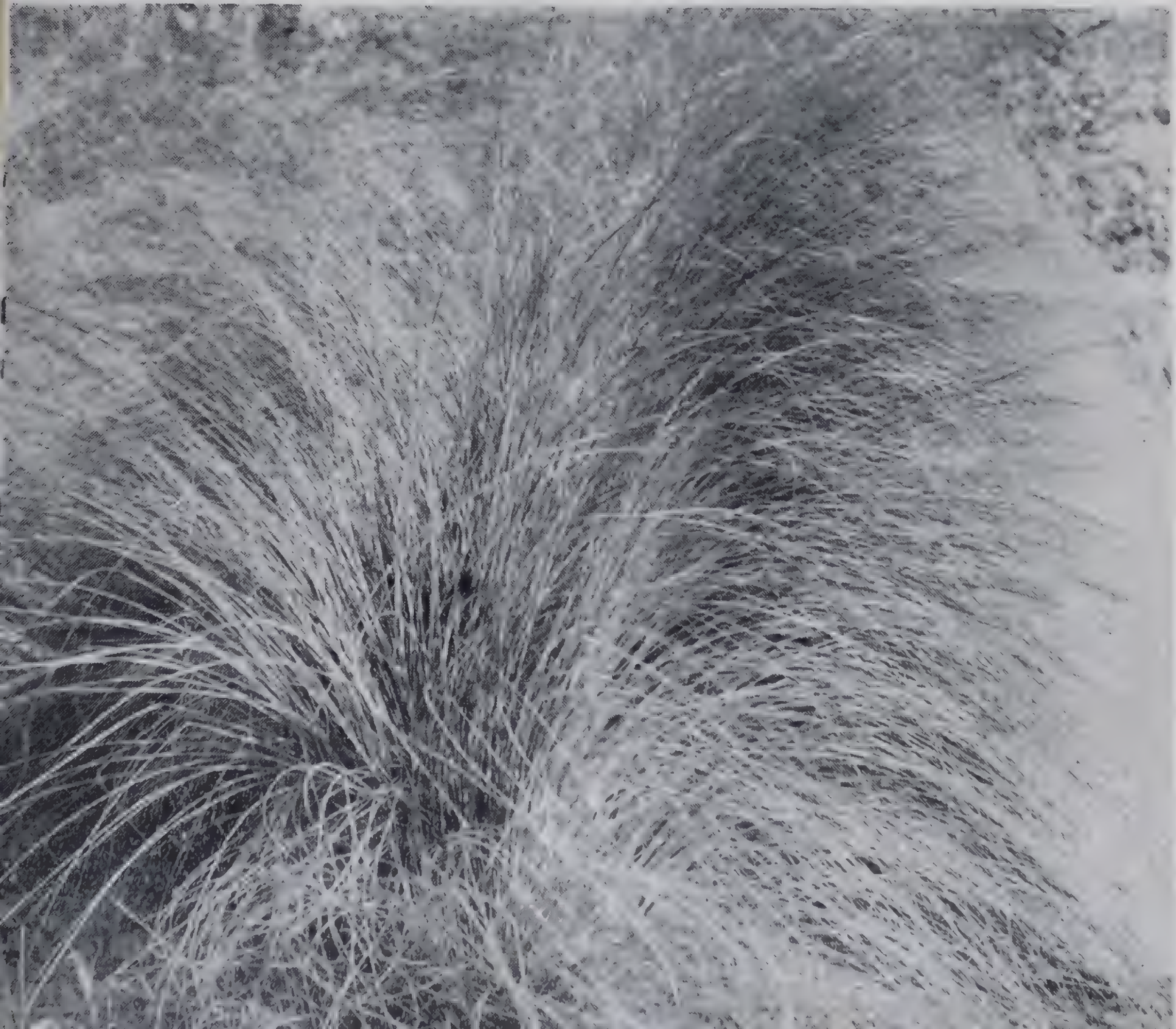


FIG. 13. One year old plants of the Kenya variety of weeping love grass (*Eragrostis curvula*)—a well known plant for soil conservation.

E.C. 953* : *Elusine* sp. From U.S.A., through Mr. Boshi Sen, Almora.

E.C. 954* : *Cynodon* sp. From U.S.A., through Mr. Boshi Sen, Almora.

Molasses grasses (*Melinis minutiflora*)

E.C. 6* : From Venezuela, through the Indian Council of Agricultural Research. Said to be insect-repellent also.

Napier grass (*Pennisetum purpureum*)

E.C. 3* : From Royal Botanic Garden, Kew.

E.C. 462 : From Director, Plant Industry, Philippines.

Sudan grass (*Sorghum sudanense*)

E.C. 247*-248* : Tift Sudan grass, Sweet Sudan grass. From United States Department of Agriculture.

Kikuyu grass (*Pennisetum clandestinum*)

E.C. 364* : From Kenya. A drought-resistant pasture grass.

Reed canary grass (*Phalaris arundinacea*)

E.C. 43* : United States Department of Agriculture, through the Indian Council of Agricultural Research.

Canary grass. (*Phalaris canariensis*)

E.C. 46* : A pasture and hay grass.

Rescue grass (*Bromus catharticus* (*Bromus unioloides*)

E.C. 44* : A pasture and hay grass.

26 *grasses from U.S.A. Soil Conservation Nursery, Arizona.* (Through Dr A. T. Sen, Ministry of Agriculture, New Delhi).

(*Bouteloua curtipendula*) : A drought-resistant pasture species. E.C. 657.

Rothrock Grama (*B. rothrockii*) : E. C. 657.

Hairy Grama (*B. hirsuta*) : E.C. 676.

Blue Grama (*B. gracilis*) : E.C. 671. Considered highly palatable and a valuable pasture plant.

Cane Blue Stem (*Andropogon barbinodis*) : E.C. 655.

———————— (*A. ischaemum*) : E.C. 656.

Little Blue Stem (*A. scoparius*) : E.C. 680.

Buffalo grass (*Buchloe dactyloides*) : E. C. 660. An important grazing grass.

Tall Fescue (*Festuca elatior* var. *arundinacea*) : E.C. 662. An ingredient in hay-pasture mixtures.

Giant Panic grass (*Panicum antidotale*) : E.C. 665*. Rich in protein.

Dallis grass (*Paspalum dilatatum*) : E.C. 666. A native of South America. A pasture grass, remains green in winter.

Pennisetum ciliare : E.C. 667. A pasture grass. In Northern India it is commonly known as *anjan* grass.

Smooth Brome grass (*Bromus inermis*) : E.C. 687. For hay and pasture.

Soft Chess or Soft Brome grass (*B. mollis*) : E.C. 709.

Harding grass (*Phalaris tuberosa* : E.C. 668 and 701. A pasture and hay grass.

Crested wheat grass (*Agropyron cristatum*) : E.C. 673. For hay and pasture.

Alkali Sacaton (*Sporobolus airoides*) : E.C. 670. Considered to be one of the best grazing perennial grasses.

———————— (*Trichachne californica*) : E.C. 669. A tufted perennial grass.

Galleta (*Hilaria jamesii*) : E.C. 675. A perennial of desert and dry plain habitats.

Kentucky Blue grass (*Poa pratensis*) : E.C. 678. An important pasture, silage and turf grass.

Needle grass (*Stipa viridula*) : E. C. 682. A grass of plains and dry slopes of central U.S.A.

Rhodes grass (*Chloris gayana*) : E.C. 683*. A perennial stoloniferous grass suitable for hay, pasture and silage. Also a sand binder.

Red Top (*Agrostis alba*) : E.C. 684. For pasture and an ingredient in turf mixtures. It is a creeping perennial growing under a great variety of conditions.

Sand Dropseed (*Sporobolus cryptandrus*) : E.C. 686. Native to sandy open ground in central and western U.S.A. and northern Mexico.

Timothy (*Pheleum pratense*) : E.C. 688. For hay, pasture and silage.

Tift Sudan grass (*Sorghum sudanense*) : E.C. 716*. From Montana, U.S.A.

Western Wheat grass (*Agropyron smithi*) : E.C. 720. From Montana, U.S.A.

Cocksfoot (*Dactylis glomerata*) : E.C. 721. From Montana, U.S.A. For hay and pasture. Valuable for dry hill slopes and high elevations.

Big Blue Stem (*Andropogon furcatus*) : E.C. 724. From Montana, U.S.A.

Alta Fescue (*Festuca elatior*. var. *arundinacea*) : E.C. 725. From Montana. A pasture-hay type.

Mountain Brome grass (*Bromus marginatus*) : E.C. 726. From Montana, U.S.A.

Crested Wheat grass (*Agropyron cristatum*) : E.C. 727. From Montana. For hay and pasture.

———————— *Agropyron cristatum* : E.C. 741. From U.S.A., through the American Embassy, New Delhi. For hay and pasture.

———— (*Agropyron sibiricum*) : E.C. 742. From U.S.A. A valuable hay and pasture plant for arid situations.

Grasses from Australia through the Head of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi :

———— (*Phalaris tuberosa*) : E.C. 750.

Cocksfoot (*Dactylis glomerata*) : E.C. 751.

Prairie grass (*Bromus unioloides*) : E.C. 752.

Perennial Rye grass (*Lolium perenne*) : E.C. 753.

Wimmera Rye grass (*Lolium rigidum*) : E.C. 754.

Grasses from Dr Bernardo Rosengurth Campo Experimental de Pastos Estoncia Rincon de Santa Elena Estacion Dr Abjandro Gallenial, Uruguay, South America :

———— (*Rottboellia selloane*) : E.C. 869.

Teosinte (*Euchlaena mexicana*) : E.C. 874. A vigorous growing tillering species closely related to maize.

Paspalum almum : E.C. 876.

P. nicorae : E.C. 877.

P. dilatatum : E.C. 929.

Tridens brasiliensis : E.C. 878.

Phalaris tuberosa var. *stenoptera :* E.C. 925.

Bromus brevis : E.C. 926.

B. coloratus : E.C. 927.

B. carinatus : E.C. 928.

Danthonia richardsonii : E.C. 930.

D. cirrhata : E.C. 931.

Giant Fescue (*Festuca arundinacea*) : E.C. 932.

Axonopus suffultus : E.C. 933. A perennial creeping grass suitable for permanent pastures.

Rhodes grass (*Chloris gayana*) : E.C. 934. A perennial hay grass.

Grasses for soil conservation

African Love grass (*Eragrostis curvula*) : E.C. 249**. From South Africa.

African Love grass (*Eragrostis curvula.* var. *valida*) : E. C. 250*. From South Africa.

Lehman Love grass (*Eragrostis lehmanniana*) : E.C. 296**. From the United States Department of Agriculture.

Weeping Love grass (*Eragrostis curvula*) : E.C. 363. From Kenya (Fig. 13).

———— *Eragrostis superba :* E.C. 661*. From Soil Conservation Nursery, Tucson, Arizona, U.S.A.

Boer Love grass (*Eragrostis chloromelas*) : E.C. 667*. From Arizona. One of the three important introduced grasses for soil conservation in U.S.A.

Lehman Love grass (*Eragrostis lehmanniana*) : E.C. 679. From Arizona.

Weeping Love grass (*Eragrostia curvula*) : E.C. 690. From Arizona. E.C. 689. From Texas.

Zoysia pungens : E.C. 710. From U.S.A. through Dr A. T. Sen. Suitable for turfs.

Bahia grass (*Paspalum notatum*) : E.C. 2*. From Kew. E.C. 873. From Uruguay.

Fodder and forage legumes

Annual Lespedeza (*Lespedeza striata*) : E.C. 343*. From U.S.A., through the American Embassy, New Delhi.

Perennial Lespedeza (*L. sericea*) : E.C. 342**. From (as above). Susceptible to cold. But can be grown as a perennial in Delhi (Fig. 10).

Barrel clover (*Medicago tribuloides*) : E. C. 5A*. From Australia. Mainly a pasture species.

Tropical Kudzu (*Pueraria phaseoloides*) : E.C. 344**. From Puerto Rico, through the American Embassy, New Delhi (Fig. 12).

Tropical Kudzu (*Pueraria phaseoloides*) : E.C. 654. From Ceylon. E.C. 705. From U.S.A. E.C. 749. From Australia (Fig. 12).

Kudzu vine (*Pueraria hirsuta*) : E.C. 704. From U.S.A. A perennial vine native to Japan and China and often grown elsewhere as a forage plant and for soil conservation.

Legumes from Soil Conservation Nursery, Arizona, U.S.A., through Dr A. T. Sen.

Blanket Indigo (*Indigofera pilosa*) : E. C. 706.

Button Medic (*Medicago orbicularis*) : E.C. 663. A useful pasture plant.

Burr Medic (*Medicago hispida*) : E.C. 707. Annual. Promising forage plant.

White sweet clover (*Melilotus alba* var. 'evergreen') : E.C. 664.

White sweet clover (*Melilotus alba*) : E.C. 693. For hay, pasture and soil improvement.

Hubam clover (*M. alba.* var. *annua*) : E.C. 696. Annual sweet white clover.

White sweet clover (*M. alba*) : E.C. 702. A variety of biennial white sweet clover.

Yellow sweet clover (*M. officinalis*) : E. C. 694. For hay, pasture and also as a bee pasture plant.

White clover (*Trifolium repens*) : E.C. 692.

Common vetch (*Vicia sativa*) : E.C. 699.

Hairy vetch (*Vicia villosa*) : E.C. 700.

From Agricultural Experiment Station, Montana, U.S.A. :

Ladak Alfalfa (*Medicago media*) : E.C. 723. For hay and pasture.

Birdsfoot Trefoil (*Lotus corniculatus*) : E.C. 719. Grown in seed mixtures.

Strawberry clover (*Trifolium fragiferum*) : E.C. 717. For pasture and hay.

Lodins' clover (*Trifolium repens* var. *lotum*) : E.C. 718.

From Auckland University, New Zealand :

Medicago glutinosa : E.C. 772. A native of Caucasia. Said to be a dense and leafy legume.

White clover (*Trifolium repens*) : E.C. 780. (Certified mother seed).

Perennial pasture (*Trifolium repens*) : E.C. 781.

Montgomery Red clover (*T. pratense*) : E.C. 782.

Broad Red clover (*T. pratense*) : E.C. 783.

From Dr Roland McKee, United States Department of Agriculture, through the Head of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi :

Korean Lespedeza (*Lespedeza stipulacea*) : E.C. 863. Annual. Valuable for grazing and hay.

Common Lespedeza (*L. striata*) : E.C. 864. Annual.

Perennial Lespedeza (*L. cuneata*) : E.C. 865. Also for soil conservation.

Sweet Blue Lupin (*Lupinus angustifolius*) : E.C. 854. As a fodder has great palatability and high protein content. Suitable for poor light land.

Sweet Yellow Lupin (*L. luteus*) : E.C. 855. A fodder crop.

Yellow sweet clover (*Melilotus indica*) : E.C. 857.

Medicago hispida : E.C. 858.

Field pea (*Pisum arvense*) : E.C. 853.

Sesbania macrocarpa : E.C. 862.

Crimson clover (*Trifolium incarnatum*) : E.C. 856. For hay.

Common vetch (*Vicia sativa*) : E.C. 850. For hay, silage and soil conservation.

Purple vetch (*V. atropurpurea*) : E.C. 851. For hay, silage and pasture.

Hairy vetch (*V. villosa*) : E.C. 852.

From Dr Bernardo Rosengurth Campo Experimental de Pastos Estoncia Rincon de Santa Elena Estac ion Dr Abjandro Gallenial, Uruguay, South America :

Desmodium discolor : E.C. 870. Perennial. Best known legume for cattle pastures on good soil in Brazil.

D. purpureum : E.C. 871.

D. batocaulis : E.C. 872.

D. cuneatum : E.C. 880.

Lespedeza hedysaroides) : E.C. 879.

Birdsfoot Trefoil (*Lotus corniculatus*) : E.C. 935. Grown in mixtures.

Trifolium ambiguum : E.C. 758.

Hairy vetch (*Vicia villosa*) : E.C. 866.

V. bengalensis : E.C. 867.

V. naturalizada : E.C. 868.

Medicinal and insecticidal plants

From Agricultural College, Lyallpur (Punjab). Original source not known :

Licorice* (*mulethi*) (*Glycyrrhiza glabra*) (Papilionaceae) : Very suitable for Delhi conditions (Fig. 8 and 9).

Henbane* (*Hyoscyamus niger*) (Solanaceae).

Wild Henbane* (*H. muticus*).

Psyllium (*Plantago psyllium*) (Plantaginaceae). Can be succesfully grown at Delhi (Fig. 7).

Derris (Tuba root) (*Derris malaccensis*) (Papilionaceae) : Source of rotenone (Fig. 5).

Peppermint (*Mentha piperita*) (Labiateae).

Tephrosia vogelii (Papilionaceae) : Source of rotenone. From East Africa. E.C. 20.

Cinchona (*Cinchona ledgeriana*) : E.C. 272. From Philippines, through the American Embassy, New Delhi.

——— (*C. succirubra*) : E.C. 271. From Philippines, through the American Embassy, New Delhi.

Wild relatives of crop plants

Wild relatives of wheat

Couch grass (*Agropyron semicostatum*) : E.C. 222*. From China.

——— (*A. elongatum*) : E.C. 240. From Australia.

——— (*A ciliare*) : E.C. 223*: From China.

Crested wheat grass (*A. cristatum*) : E.C. 673*. From U.S.A.

Western wheat grass (*A. smithi*) : E.C. 691. From Soil Conservation Nursery, Arizona.

Western wheat grass (*A. smithi*) : E.C. 720. From Montana, U.S.A.

A. sibiricum : E.C. 742*. From U.S.A., through the American Embassy, New Delhi.

A. scabrifolium : E. C. 923*. From Uruguay.

Aegilops triuncialis : E.C. 209*. From Kew.
A. ventricosa : E.C. 208*. From Kew.
Russian wild ryegrass (*Elymus junceus*) : E.C. from Australia.
E. dahuricus : E.C. 808. From Australia.
Brachypodium phoenicoides : E.C. 245. From U.S.A.

Wild relatives of barley.

Hordeum stenostachys : E.C. 924. From Uruguay.

Wild relatives of oat.

Avena ludoviciana : E.C. 920. From Uruguay.
A. strigosa : E.C. 921. From Uruguay.
A. fatua : E.C. 708*. From San Fernando Nursery, U.S.A.

Wild relatives of maize.

Teosinte (*Euchlaena mexicana*) : E.C. 874*. From Uruguay.

Wild relatives of tomato.

From Dr L. C. Luckwill, Long Ashton, Bristol, England.

Potato leaf (*Lycopersicon esculentum.* sub sp. *typicum* var. *grandifolium*) : E.C. 478.
L. esculentum, sub. sp. *intermedium* : E.C. 479.
L. esculentum typicum var. *pyriforme*) : E.C. 481*.
L. esculentum typicum : var. *validum* : E.C. 482*.
L. esculentum typicum : E.C. 478.
L. esculentum sub. sp. *gleni* : E.C. 488, 489 and 490.
Yellow currant (*L. pimpinellifolium*) : E.C. 483*.
Red currant (*L. pimpinellifolium*) : E.C. 484*.
L. esculentum sub. sp. *Humboldtii* : E.C. 485.
L. hirsutum var. *agrimoniaefolium* : E.C. 486.
L. peruvianum sub. sp. *dentatum* : E.C. 492*.
L. peruvianum sub. sp. *puberulum* : E.C. 493*.
L. peruvianum sub. sp. ? : E.C. 494*.
L. glandulosum : E.C. 495.

Other plants

Buckwheat (*Fagopyrum esculentum*) : E.C. 322*, 323*. From China. Early maturing varieties (Fig. 3).
Caesalpinia sepieria : E.C. 35*. From Kenya. A hedge plant.
Tephrosia candida : E.C. 19*. From East Africa. A shrub useful as a cover plant in plantations and also for green manuring.

Indigenous collection

Food plants

Tapioca (*Manihot utilissima*) : Euphorbiaceae. Three varieties namely Ariyan, Kalikalan and Anakomban received from Travancore. The general growth of the plants at Delhi is shown in Fig. 1.

Fodder and forage grasses

*Apluda aristata** : A good forage grass of Simla hills. Well-acclimatized at Delhi.
*Bromus unioloides** : From Simla. Well-acclimatized at Delhi.
*B. japonicus** : From Quetta, Baluchistan.
*Chrysopogon montanus** : A drought-resistant perennial grass.
Anjan grass (*Cenchrus ciliaris**) : Perennial pasture grass.
Anjan grass (*C. setigerus**) : Allied to above.
*Eragrostis gangetica** : Originally from Puri (Orissa). Resembles African Love grass. Said to be valuable for cattle fodder, both fresh and dry.
*Lolium perenne** : From Quetta, Baluchistan.
*Phalaris minor** : An annual winter grass. Grows prodigiously.
*P. paradoxa** : From Baluchistan.
*Pennisetum orientale**) : A perennial grass of Himalayan ranges, acclimatized at Delhi.

Fodder and forage legumes

(*Alysicarpus rugosus**) : A quick-growing fairly tall annual.
(*Atylosia scarabaeoides*) : A twining legume.
Wild Sword Bean (*Canavalia virosa**) : A prolific legume growing wild at Baroda. Grows well at Delhi under cultivation.
*Indigofera trifoliata** : A fairly quick-growing vigorous legume from Central Provinces, suitable for growing in the hot weather and rainy season.
*I. linifolia** : A rainy season annual.
Senji (*Melilotus alba**) : Local wild white sweet clover.
Senji (*M. indica**) (*M. parviflora*) : Local wild yellow sweet clover.
Maina (*Medicago denticulata*)* : A winter legume.
*Phaseolus trilobus** : For fodder and green manuring.
Wild Fenugreek (*Trigonella polycerata**) : A winter legume.

Vetch (*Vicia sativa**): Local wild variety.
*V. hirsuta**: Local wild variety.

Other legumes

Avaram bark (*Cassia auriculata**): For green manuring and tanning purposes. Originally from Rajputana.
C. hirsuta: From Jeypore (Orissa). A leafy herbaceous shrub.
Bara Panwar (*C. occidentalis**): Delhi local.
Panwar (*C. obtusifolia**): Delhi local.
*C. sophera**: From Mussooree.
*C. sophera** var. *purpurea**: A hedge plant.
Wild indigo (*Indigofera tinctoria**): Wild in Delhi.
*I. hirsuta**: A possible green manuring plant.
Lespedeza (*Lespedeza cuneata=L. sericea*): Collected from Himalayan ranges and grown at Delhi.
Tropical Kudzu (*Pueraria phaseoloides*): Collected from Dehra Dun.
*Rhyncosia aurea**: A trifoliate trailing legume of rainy season.
*Tephrosia purpurea**: A possible green manuring and insecticidal plant.

Fibre plants

*Corchorus olitorius**: (Tiliaceae): Wild variety of the jute species. Delhi local.
(*C. capsularis**): Wild variety of the common jute species. From Karnal (East Punjab).
Wild *Okra* (*Hibiscus ficulneus**) (Malvaceae):
(*H. micranthus*): A perennial plant growing on the dry ridge at Delhi.
Aramina (*Urena lobata*): A perennial fibre plant (Fig. 11).

Medicinal and insecticidal plants

(*Artemisia vulgaris**): Compositae. From Bhowali (Nainital). Yields santonin which is used for expelling worms from the intestines.
(*Chenopodium ambrosoides*) (Chenopodiaceae): Yields oil of chenopodium used in expelling worms from the intestines. Originally from Bhowali (Nainital).
Jimson weed (*Datura stramonium**) (Solanaceae): Purple and white-flowered varieties. Yields the drug stramonium.
(*D. metel**): Purple and white-flowered varieties.
(*Lallemantia royleana**) (Labiatae): The mucilaginous seeds are medicinal in the indigenous systems of medicine.
Isafgol (*Plantago ovata*) (Plantaginaceae): Seeds medicinal. Grown successfully at Delhi (Fig. 6).

Wild relatives of cultivated plants

Wild relatives of brinjal or eggplant (Solanum melongena *L.*):
- *S. incanum**: A hardy perennial solanum the fruits of which are resistant to borer attack.
- S. *indicum**: A small-fruited spiny plant, with all flowers long-styled.
- S. *torvum**: A perennial bushy species with small berries.
- S. *xanthocarpum**: A drought-resistant spreading annual.
- S. *verbasifolium**: A non-spiny shrubby plant.
- S. *hispidum**: A grey-tomented tall-growing plant from Dehra Dun—Mussooree area.
- *S. khasianum**: A frost-resistant species, susceptible to heat. Spiny with non-bitter fruit.
- S. *nigrum** (*makoh*).

Wild relatives of sann hemp (sanai) (*Crotalaria juncea*) (Papilionaceae):
- *C. sericea**: A leafy rather slow-growing legume with bold flowers. Delhi local and Cuttack (Orissa) varieties.
- *C. retusa**: A low, much branched herbaceous plant. From Baroda and Cuttack (Orissa).
- *C. usaramœnsis**: A slow-growing fairly tall plant. Late in flowering.
- *C. lanceolata**.
- *C. mysorensis**: A very early maturing species. Delhi local.
- *C. tetragona**: From Dehra Dun.
- *C. medicaginea**: An erect trifoliate legume resembling lucerne in general habit. It is an annual.
- *C. orixensis*: A spreading trifoliate legume. From Nagpur.
- *C. pumilla*: A simple-leaved legume with basal shoots spreading on the ground. Main shoot rather erect. From Nagpur.

Wild relatives of bhendi *or* okra (*Hibiscus esculentus*) (Malvaceae) :

H. ficulneus :* From Delhi, East Punjab, Guntur (S.I.), Ratlam (C.I.).
H. tetraphyllus:* From Baroda, Bengal, Saharanpur (U.P.)
H. pungens : From Dehra Dun.
H. abelmoschus : From Dehra Dun.
H. rugosus : From Nagpur.

Wild relatives of wheat (Triticum spp.) (Gramineae) :

Agropyron semicostatum : Himalayan
A. longe-aristatum : Himalayan.
Aegilops squarrosa :* From Quetta, Baluchistan.

Wild relatives of Barley :

H. murinum : From Quetta, Baluchistan.
H. distichon : From Quetta, Baluchistan.

Wild relatives of maize (Zea Mays) :

*Coix lachryma-jobi** (Job's tears) : From Dehra Dun.
Euchlaena mexicana :* Teosinte.

HYBRID *CUMBU*

TWO new hybrid *cumbu* varieties X.1 and X.2 were recently released for trial from the Millet Breeding Station, Coimbatore. They have been produced by crossing promising pure lines which exhibited the maximum hybrid vigour when crossed. District trials, conducted in Tiruchirapalli district in the Musiri and Perambalur taluks have been very encouraging. Extensive trials are being arranged in the coming season to find other areas suitable for cultivating the hybrid *cumbu* X.1 and X.2.—*Agricultural Newsletter, Madras,* July, 1949.

I

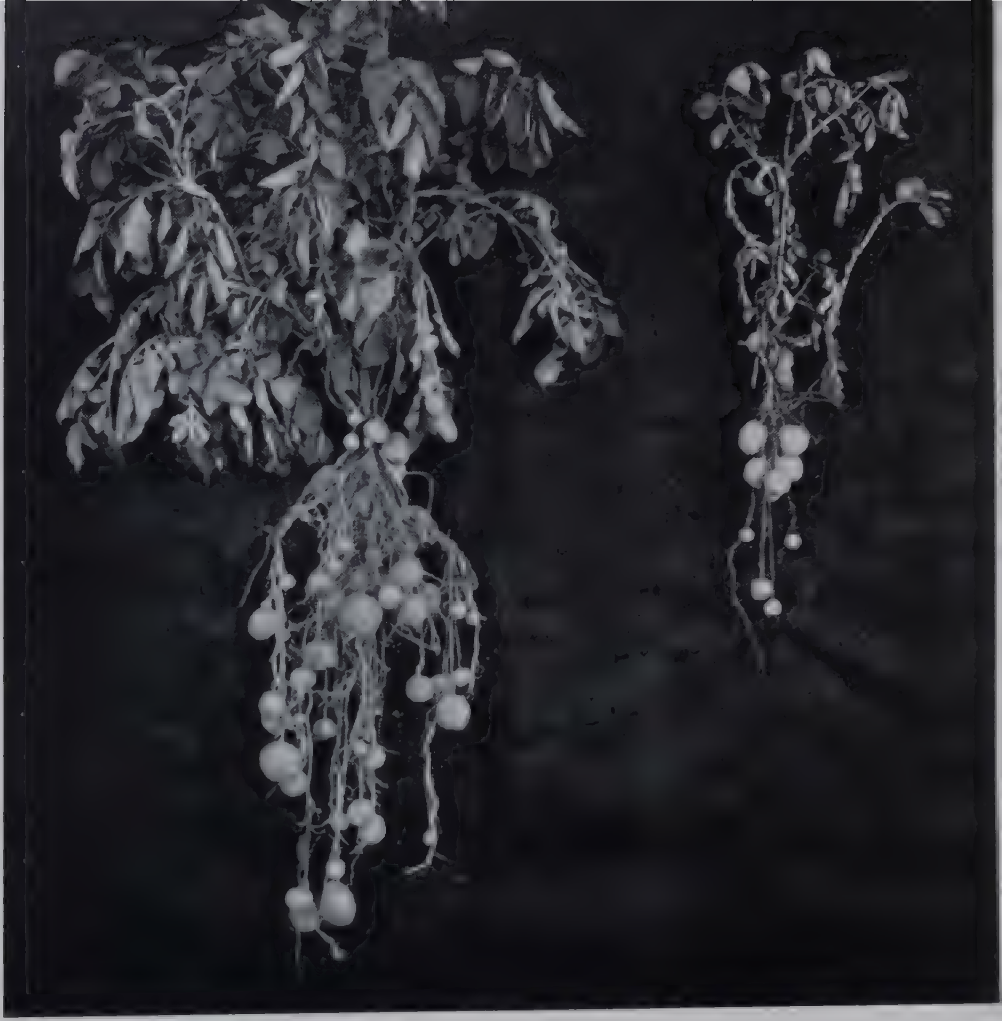
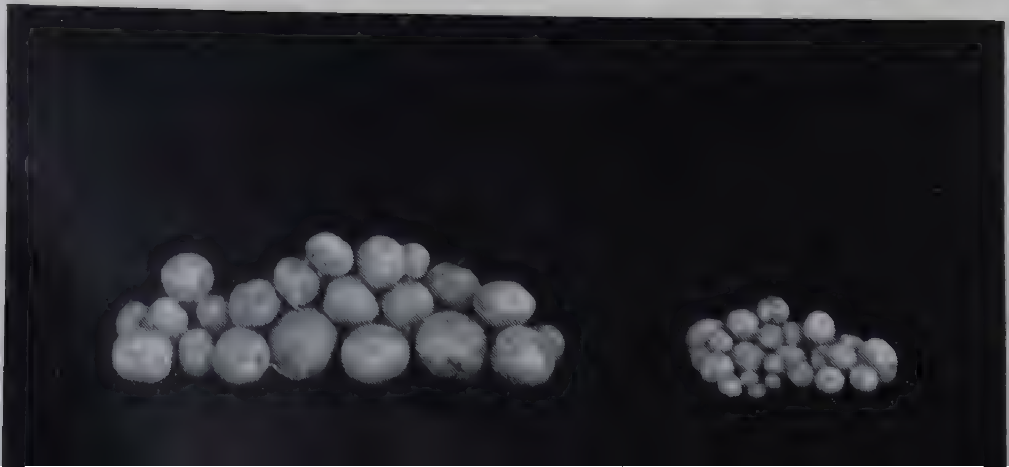


FIG. 1. Partially disease-free potatoes

FIG. 2. Partially disease-free potatoes



SEED FROM PARTIALLY DISEASE-FREE POTATO CROP

By R. S. VASUDEVA and R. N. AZAD

THE virus diseases of potato are common wherever potato crop is cultivated and cause considerable losses in yield every year. The survey conducted of all the main potato-growing areas in Northern India in this connection has established the widespread occurrence of virus diseases and their high incidence in some localities. With a view to establish the potato industry of the country on a sound basis so that a regular flow of potatoes, which is an important food commodity, is ensured, it is imperative that largescale production of seed potatoes of high quality, free from disease and varietal mixture, be undertaken. With this object in view the Indian Council of Agricultural Research have already taken steps for the certification of seed potatoes in the country, and a scheme in this connection is in operation at the Indian Agricultural Research Institute since 1942. Though the building up of nucleus and large-scale production and distribution of seed potatoes is the only practical method of combating virus diseases, it involves a long range work which is to be carried out over several stages and will take a number of years before disease-free certified seed is available to the cultivators. This scheme cannot, therefore, contribute to the promotion of food production immediately in these days of serious food deficit in the country. As an immediate step to increase the outturn of potatoes per acre, the Indian Council of Agricultural Research launched a scheme on the same principles as seed potato certification but for the production of partially disease-free seed, free from severe types of mosaic, streak and leaf roll which could be made available to the cultivators without delay.

In partially disease-free seed potatoes freedom from serious types of virus diseases is more or less achieved, and this alone brings about substantial increase in yield per acre. Figures 1 and 2 show apparently healthy and mosaic-affected plants of potato var. *Phulwa* with their respective yields.

Production of partially disease-free seed potatoes

(a) The procedure adopted to achieve this object is briefly described below. Production of partially disease-free seed potatoes is based on the principle of 'mass roguing' of diseased plants. An isolated piece of land about 500 ft. away from other potato fields is taken and planted with commercial seed of the desired variety. It is however desirable that the seed material for initial planting is selected from a crop having a low disease incidence. Clean cultivation and elimination of all weeds throughout the growing period of the crop are also important. The crop is to be constantly kept under observation. Individual plants are examined for disease symptoms at regular intervals and all the plants exhibiting severe types of symptoms are immediately rogued out. While roguing care should be taken so that no portion of the diseased plant is left over in the field and all the tubers along with the plants are removed. The plants soon after roguing are taken in a closed container to prevent the escape of insect vectors away from the seed plot and buried. Any off-type plants are also rogued out during these operations in order to ensure the purity of variety. During roguing and cultural operations hands and tools should be disinfected to reduce the spread of the disease to the minimum. In order to avoid secondary infection the crop should be lifted comparatively early, i.e. soon after the foliage becomes pale. Success of the operation depends on 'thoroughness' and 'earliness' of roguing so that the plants showing the first symptoms of disease are immediately eradicated.

(b) The production of partially disease-free seed potatoes was undertaken at the

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Indian Agricultural Research Institute and the results are briefly described below. In 1944 seed potatoes of *Phulwa* and *Darjeeling Red Round* varieties were purchased from pockets of low disease incidence and planted at the Agricultural Sub-Station of Indian Agricultural Research Institute, Karnal. The initial infection in the crop varied from 21·0 to 27·0 per cent. But in 1945 part of the material raised from the previous crop was planted and about 22 acres of standing crop with comparatively low disease incidence was purchased at Hapur in the United Provinces. In view of the previous year's experience, in 1946 after survey the entire crop with low disease incidence was purchased. The work during the later two years was confined to *Phulwa* variety. During 1944, 1945 and 1946 altogether 963, 2,782 and 3,026 maunds respectively of seed material were distributed to Provincial and State Governments as well as to Military Farm Depots in certain areas. The major portion of the material was, however, taken over by the United Provinces Department of Agriculture for further multiplication and distribution. The records of performance were supplied by the United Provinces Department of Agriculture.

Performance

The Department of Agriculture, Bihar, which took over a small quantity of seed potatoes from the first lot in 1945 observed that the crop raised from the partially disease-free seed, supplied under the scheme, showed 3·5 per cent disease incidence as against 15 to 25 per cent in the local crop.

The crop raised from seed material supplied to the United Provinces exhibited considerably low disease incidence as compared to the local crops. The yield of tubers raised from such seed was also considerably higher than that raised from the local crops. During 1947-48 a maximum yield of 427 maunds per acre was obtained at Hapur and this has been considered by the Department of Agriculture, United Provinces, to be the record yield for *Phulwa* variety.

The disease incidence and outturn of potatoes from the seed supplied under the scheme and the local crops are compared in Table I.

TABLE I

Disease incidence and yield from crop raised from partially disease-free seed

Year	Locality	Partially disease-free seed		Commercial seed		Maximum yield in maunds per acre from partially disease-free seed
		Per cent disease incidence	Yield in maunds per acre	Per cent disease incidence	Yield in maunds per acre	
1945-46	Meerut	3·5	233	20–25	175	300
	Farrukhabad	2–10*	235	60–70	200	322
1946-47	Hapur	3–4	250	20–70	175	...
	Farrukhabad	1–2	220	50–60	150–200	300
1947-48	Hapur	1–2	250	50–75	125	427
	Farrukhabad	...	250	...	...	...

* The higher disease incidence in Farrukhabad area appears to be due to the badly infected neighbouring crop.

The performance of partially disease-free seed potatoes distributed under the scheme has obviously been extremely satisfactory from the point of view of disease incidence and outturn. The germination was almost 100 per cent in all the localities where the seed was grown. It has generally been observed that the crop raised from partially disease-free seed potatoes suffered less from the adverse effect of frost as compared to the local crop and that the seed appeared to be of better keeping quality. The crop was also not so severely affected by early blight which appeared in an epidemic form at Hapur in 1947-48. The general growth and development of plants was found to be very satisfactory with the result that the growers in those localities have shown keenness for having their crop examined for diseases and obtaining disease-free seed material because of the additional benefit accruing from it. It is, therefore, essential that till disease-free certified seed stocks are available to the growers for distribution, partially disease-free seed material be multiplied on a large scale and made available to the growers as it would considerably help in increasing the output of potatoes per acre.

Thanks are due to late Mr. O. P. Rikhi for his untiring efforts and assistance in the production and distribution of seed material. Thanks are also due to Thakur Ram Surat Singh, Deputy Director (Gardens), Lucknow, for his constant cooperation during the course of this work.

LOCUST VISITATIONS

VISITATIONS of locusts which have, from times immemorial, been considered as one of the major enemies of agricultural production have always been periodical and during the last 140 years, some 14 outbreaks covering a period of 10 years on an average have occurred in India. The last two outbreaks, covering the periods 1926-31 and 1940-46 were quite serious. A good rainfall which is a boon to the cultivator in many ways provides, however, the most favourable condition for locust breeding. The fecundity of the locusts is very great : one pair alone is capable of producing nearly 5,000 adults within a period of five months. (*P.I.B.*)

COST OF PRODUCTION OF WHEAT ON THE GOVERNMENT FARM, KALYANPUR (KANPUR)

By G. D. AGRAWAL and RAM SARAN

'FARM Management Studies' represent the most neglected branch of agricultural researches in India. Even the importance of 'Cost of Production Studies' has been seldom realized. They are conspicuous by their absence particularly on a continuous basis save the Punjab where farm accounts are published yearly by the Punjab Board of Economic Enquiry. The need of such studies was never more than today when the State has to adopt a number of measures, e.g. price stabilization, abolition of *zamindari*, fixing of fair rents and minimum agricultural labour wages, crop insurance, etc. In the following article cost of cultivation and production of wheat has, therefore, been studied on a long term basis since 1939-40.

Kalyanpur Farm

Kalyanpur Farm is situated on the Grand Trunk Road nearly five miles from Kanpur city. The farm is canal-irrigated and possesses fertile irrigated loam which gives luxuriant plant growth. Wheat is generally taken after fallow or green manuring with *sanai*. The cultivation operations consist of two to three ploughings with soil-turning plough and five to six ploughings with *desi* plough. Two irrigations followed by weeding and hoeing are given. In years of deficient rainfall, however, towards the end of September the fields have to be irrigated before preparatory tillage, increasing the number of irrigations to three. Often six to eight cartloads of farmyard manure are applied, per acre, to wheat when sown after fallow. Cakes or fertilizers are occasionally used. The crop is usually sown by the middle of October and matures in about six months, i.e. mid-April. The average area under the crop, on the farm, is about 60 acres.

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Cost of cultivation

Table I gives the cost of cultivation and gross and net incomes per acre together with the cost of production per maund of wheat grain. The war had increased the cost of temporary labour and bullock feeds. This is partly responsible for a little rise in the total cost of cultivation. But the price disturbances soon subsided and the average of the two years, i.e. 1939-40 and 1940-41 is a fairly representative figure for the cost of cultivation of wheat before the war.

Strictly speaking it may be pointed out that the yearly cost figures of Table I are not good comparables, being dependent on natural and local factors which materially change the cultural operations schedule of a year. Of the former, the amount and distribution of rainfall and of the latter the availability of labour and the manure supply are of importance. Also the different cultivation practices, e.g. the number of ploughings, interculture and irrigations have not been uniform in all the years.

The rise in the cost of cultivation since 1940-41 has been almost continuous. The year 1945-46 witnessed the highest increase, the index* having risen to 207. A detailed study of the cultivation records has revealed that, taking into account the individual items, the highest increase has been in the case of seed and manure, the indices being 396 (in 1944-45) and 395 (in 1945-46) respectively. The next highest increase is to be found in bullock and human labour in 1945-46, the indices being 268 and 208 respectively.

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* The base, for all the indices given in the article is the average of 1939-40 and 1940-41.

TABLE I

Cost of cultivation per acre in rupees

Year	Labour	Bullocks	Other expenses	Total expenditure.	Total income	Profit and loss	Cost of production (per maund of grain)	Yield of grain per acre	Wholesale harvest price of grain (per maund)	Market rate of *bhusa* (per maund)
								Md.	Rs.	as.
1939–40	42·98	49·17	68·55	160·70	140·22	20·48	4·40	28·68	3·69	0·67
1940–41	33·33	32·22	56·34	121·89	164·81	42·92	2·11	30·96	3·50	1·00
1941–42	33·64	35·19	80·50	149·33	239·90	90·57	2·89	25·95	6·38	1·60
1942–43	27·33	34·37	88·59	150·29	394·83	244·54	2·85	23·51	13·25	20·0
1943–44	37·40	67·18	98·32	202·90	311·03	108·13	4·35	15·12	11·50	5·00
1944–45	47·86	71·46	99·30	218·62	351·05	132·43	5·23	20·42	11·69	2·86
1945–46	79·44	108·96	105·32	293·72	413·02	119·30	6·61	20·94	12·31	4·00
1946–47	57·48	106·60	100·63	264·71	374·35	109·64	7·12	21·14	12·31	3·00
1947–48	62·37	91·99	107·31	261·67	590·99	327·32	6·88	21·65	22·00	3·00

'Other Expenses' in Table I column 4 include expenditure on land, seed, manure, irrigation, machinery, repairs of the dead stock, supervision, miscellaneous, interest on working capital and lastly the depreciation and interest on fixed capital. The charges under land and depreciation and interest on fixed capital have remained stationary. Supervision charges have increased since 1942-43 owing to an increase in pay and war allowances of the supervisory staff. The interest has been charged at the rate of 6 per cent per annum for six months on the total working capital and at the rate of 3 per cent on the fixed capital. It is clear that the increase in cost has been all round except land and depreciation and interest on fixed capital. The two main factors which have materially influenced the rise of cost of cultivation as a whole are human and bullock labour as they together constitute 57·4 per cent of the total cost of cultivation of the crop.

Cost of production

With the rising prices the cost of cultivation per acre has shown a progressive increase. Ordinarily it varies within a narrow range but the cost of production per maund of grain shows wide and violent fluctuations as it depends on the yield which itself is very variable and uncertain on account of a number of natural factors over which human agency has no control. The variation in the yield of grain per acre is from 15·12 to 30·96 maunds, the average for the period being 23·16. Similarly the cost of production per maund has varied from Rs. 2·11 to Rs. 7·12, the average being Rs. 4·74. The average cost of production for the last three years, however, is Rs. 6·87. The cost of production of grain has been calculated after deducting the income from *bhusa* from the total income.

Table II gives the percentages of expenditure under different heads for the pre-war period and the present times and shows how the relative different rates of increase have affected their relationship to the total cost during the two periods.

As rent and irrigation charges have varied but little, the per-war ratio of their cost to the total cost of cultivation, i.e. 11·9, has come down to 7·1 for the current years. Supervision too shows a decrease but much less when compared to that of rent and irrigation. Percentage expenditure on bullock labour has, on the other hand, increased from 28·8 to 36·4. The increase is due to the high maintenance cost in spite of nearly three times increase in the wages, the decrease in the ratio of labour cost to total is due to a reduction to half in the quantity of labour units used.

Table III below gives the extent of human labour and cattle hour units* used per acre and their rates per day.

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*Human labour and bullock hour units mean the amount of work done by a male adult and by one pair of bullocks, for one hour respectively.

8-hour units make 1 labour day.

TABLE II

Expenditures under various heads per acre

Heads of expenditure →	Land	Labour	Bullocks	Manure	Seed	Irrigation	Machinery	Repairs of dead stock	Supervision	Miscellaneous	Interest on working capital	Depreciation and interest on fixed capital	Total
Pre-war (Average of 1939-40 and 1940-41)													
*1. Actual expenditure	10·5	38·16	40·69	8·44	4·66	6·34	3·35	6·26	8·75	0·46	3·69	10·00	141·30
2. Percentage to total	7·4	27·00	28·8	6·0	3·3	4·5	2·4	4·4	6·2	0·3	2·6	7·1	100·0
Present (Average of 1946-47 and 1947-48)													
*1. Actual expenditure	10·5	59·93	96.30	23·73	16·31	7·65	7·91	11·41	12·50	0·00	6·94	10·00	263·18
2. Percentage to total	4·2	22·7	36·4	9·2	6·2	2·9	3·0	4·3	4·7	0·00	2·5	3·8	100·0

* Figures are in rupees.

TABLE III

Labour and cattle hour units used and their rates

Year	Per acre				Per hour unit					
	Temporary labour	Permanent labour	Total labour	Cattle	Temporary labour		Permanent labour		Cattle	
					as.	ps.	as.	ps.	as.	ps.
1939–40	609·6	345·6	955·2	184·8	0	7·14	0	11·28	4	1·0
1940–41	603·2	203·1	806·3	154·5	0	7·03	0	11·93	3	9·0
1941 42	386·2	294·1	680·3	152·5	0	7·68	0	11·78	3	9·0
1942–43	218·9	270·4	489·3	92·2	0	8·73	1	0·40	6	2·0
1943–44	213·0	243·2	456·2	106·6	1	0·70	1	6·70	10	1·9
1944–45	155·9	294·6	450·5	91·5	1	0·20	1	9·47	12	8·0
1945–46	157·3	303·6	460·9	123·5	1	5·33	2	8·33	12	2·0
1946–47	100·2	348·3	448·5	94·8	1	5·00	2	2·89	16	6·0
1947–48	145·4	320·3	465·7	125·2	1	7·48	2	4·52	11	9·0

There has been a remarkable decrease in the use of temporary labour because of its scarcity. Whereas the average employment per acre during 1939-40 to 1941-42 was 67 labour days of the temporary labour and 35 of the permanent, the former has come to even less than half of the permanent in the current years. Last nine years' average of labour days is 75 of labour and 16 of cattle.

Temporary and permanent labour rates have increased nearly three times, the indices being 272·9 and 286·6 respectively while the increase in cattle rates is more than four times, the index having risen to 438·8.

Cultivator's cost of production

It would be wrong to consider these figures as representative of the farmer's costs. Whereas the Government farms are able to obtain most of their supplies at controlled prices, cultivators have to pay enormously. For instance, the farm under study gets cattle dung and wool waste manures on very favourable terms from the municipal markets and the local woollen mills, the facilities forbidden to cultivators. The high prices of capital items, e.g. the bullocks, implements, machinery, etc. are not reflected at all in this study for the farm is an old established one and replacements during these years have been few. Cultivator's poverty stands in the way of the use of the desired quantity of capital. He invests little on farm buildings, bullock-shed, land improvement, fencing, better implements and good bullocks. In spite of the very high rent which he has to pay he fails to make the best use of the land on account of lack of funds and facilities of good seed, adequate quantity of manure, irrigation, etc. His bullocks are small, under-sized and half-starved. The small holding hinders his putting any area under fodder for his stock. This all is reflected in poor tillage and low yield. His cost of cultivation per acre is, therefore, less but considered relatively is considerably higher. His average cost of production per maund can safely be said to be more by 25 to 50 per cent. This is further supported by the studies of the Agricultural Economics Section of the Government Agricultural College, Kanpur, on the cultivators' holdings for 1946-47 and 1947-48. However to obtain representative figures, there is great need for setting up organizations for such study in the provinces of India. The importance of cost studies on long term basis on representative holdings of cultivators need not be further emphasized. Their absence leaves a vacuum in the economic researches carried out in the country as a whole.

Acknowledgment

We wish to acknowledge our thanks to Dr B. L. Sethi, Principal, Agricultural College, Kanpur, and formerly Officer-in-Charge, Government Farm, Kalyanpur, for permitting us to make use of the farm records.

THE *per capita* expenditure on agriculture is annas 11 in India as against Rs. 20 as. 14 p. 5 and Rs. 77 as. 9 p. 11 in Canada and the U.S.A. respectively. (*P.I.B.*)

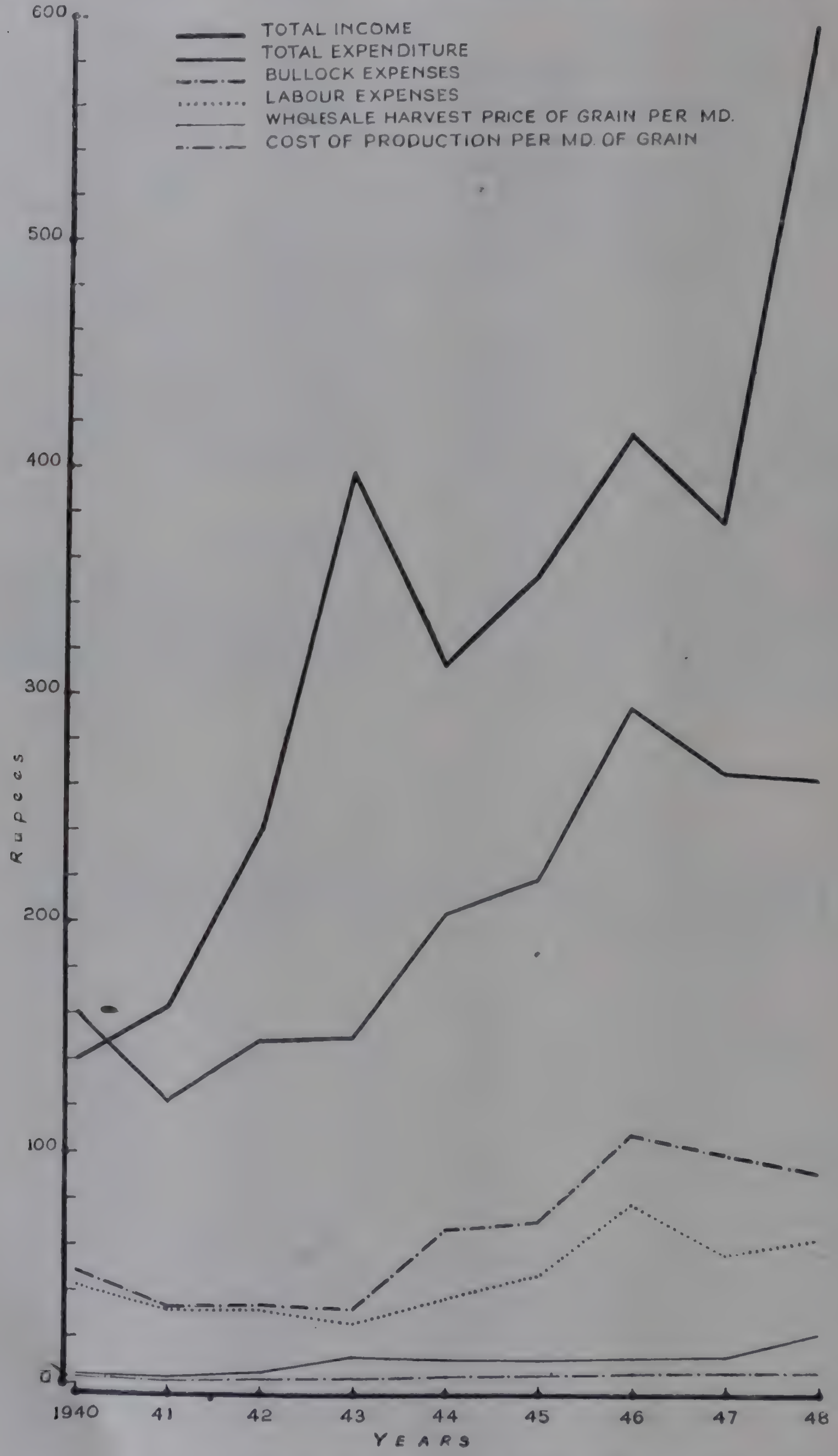

FIG. 1. Graph showing the cost cultivation of wheat, 1940 means 1939-40

FREEZING POINT OF MILK AND ITS APPLICABILITY TO DETECT ADULTERATION OF MILK

By NOSHIR N. DASTUR

COMMON tests like fat and solids-not-fat usually applied for the detection of adulteration of milk with water allow a considerable amount of adulteration to take place. This is largely due to the fact that pure milk shows great variation in composition, and also because buffalo milk which is richer in total solids than cow milk is used freely for adulteration. A method that will permit the detection of adulteration with very small quantity of water will, therefore, prove useful and help to check this evil which is widespread in the urban centres. This method should be such that it can be used with cow and buffalo milk without creating ambiguity.

A test which is finding greater use for quality control work is the freezing point of milk. The freezing point depression of milk is produced by constituents which are in solution in the milk serum, the most important of which are lactose and chloride. These together account for nearly 75 per cent of the observed depression in freezing point. The amount of lactose and chloride in milk are so adjusted by nature that any increase in one results in a corresponding decrease in the other and *vice versa*. It is largely for this reason that milk has such a constant freezing point. Constituents like fat and casein which are not in true solution in milk do not contribute anything to the observed value. This makes the test independent of the most variable factor in milk, namely, its fat percentage, and so useful for detecting adulteration. A series of exhaustive investigations with the milk of western breeds of cattle have shown that the freezing point depression is the most constant physical property of milk and is not affected by such factors as naturally occurring low solids-not-fat or any hereditary and environmental factors. The minimum depression now utilized for legal purposes in western countries is 0·530°C. Application of this test in India can therefore be expected to furnish a remedy for the difficulties already mentioned. Before this can be done, it is necessary to find out the freezing point of large number of cow and buffalo milk samples, and likely factors which may influence the value. A detailed study was therefore taken up recently at this Institute under a scheme financed by the Indian Council of Agricultural Research. In the following a summary of important results is given.

The freezing point of milk can be determined by using different techniques but for analytical work the determination is always done with the Hortvet Cryoscope. The apparatus consists of a thermos flask in the centre of which is kept a glass tube containing the sample of milk. Surrounding this tube is a metal tube with a very small air gap in which is put some alcohol to make an even contact. The flask contains ether in which the metal tube dips. In the tube containing milk a special thermometer is kept which reads between the range +1° to −2°C. The thermometer should be of guaranteed accuracy and capable of reading to 1/1000 of a degree. When air is blown through ether, due to evaporation of ether, the temperature of milk begins to fall. Actually the milk is super-cooled to about −1°C. At this stage a tiny crystal of ice is introduced to start freezing when the temperature begins to rise and reaches a steady value. This is taken as the freezing point of milk. When using the apparatus a constant check is kept over the accuracy of the thermometer. The reading obtained is not the true freezing point of milk as the apparatus gives a value which is lower by 0·015°C. However, according to accepted standard no attempt is to be made to correct the observed reading.

Minimum freezing point of milk

Trials were first carried out with samples of milk of known purity to find out the average value for freezing point and the likely variations. For this purpose nearly 560 composite samples

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of milk from Gir, Sahiwal, Sindhi, Tharparkar and cross-bred cows, and 200 samples of Dharwar and Murrah buffalo milk produced in the Institute farm were analyzed over a period of 18 months. The average freezing point of cow milk samples was —0·548°C., and that of buffalo milk —0·549°C. Over 97 per cent of all the samples examined show freezing point depression greater than 0·530°C., and so this value can be taken as the minimum limit for prescribing legal standards. In the case of cow milk nearly 96 per cent of the samples had freezing point within the range of —0·531°C. to —0·560°C. Buffalo milk samples show a wider scattering, only about 81 per cent of the samples lying within the range noted above.

The above results were obtained under Bangalore conditions, but to verify them nearly 300 samples of pure milk were collected from different farms in India and tested by this method. The samples were preserved with mercuric perchloride added at the rate of 0·075 per cent. By this method it was possible to preserve milk over a month. The observed freezing point was corrected by —0·200°C. as the preservative added lowers the freezing point. The results again confirmed that the minimum depression for milk can safely be taken as 0·530°C.

Effect of various factors on the freezing point

It is well known that the composition of milk is affected by several factors, e.g. the breed, individuality, season, stage of lactation, feed, etc. The effect of some of these factors was therefore studied with a view to find out how they will affect the results of freezing point test.

(i) *Breed of the animal :* Freezing point of milk of cross-bred, Gir, Sahiwal and Sindhi cows, and Murrah buffaloes were determined. The average freezing point depression was within the very narrow range of 0·546° to 0·549°, thus indicating that not only the breed of the animals had no marked effect on this value, but also that cow and buffalo milks give the same average value.

(ii) *Individuality of animals :* A further study was carried out involving the analysis of nearly 580 samples collected from individual animals of Sindhi and Murrah breeds. The average freezing point was —0·549°C., and nearly 96 per cent of samples gave freezing point depressions greater than the minimum value of 0·530°C. The test is therefore equally useful, both for mixed milk samples and for samples from individual animals.

(iii) *Freezing point of colostral milk :* Colostrum gives a greater depression than normal milk, the average being 0·580. This larger depression in the freezing point will not in any way interfere with the application of this test for legal work, as for quality control only the minimum value is of importance.

(iv) *Effect of season :* The values for the freezing point of milk from different breeds of animals studied over a period of one year did not reveal any change which could be ascribed to the change in the seasons.

(v) *Effect of separation and boiling :* Separated milk, prepared from the same samples of whole milk gave identical freezing point. This, as already indicated, is due to the fact that milk fat which is in the form of an emulsion does not contribute anything towards the observed freezing point depression. Heating milk to pasteurization temperature had no effect on the freezing point. Boiled milk shows greater depression than raw milk and this value does not change on storing the heated samples.

(vi) *Effect of preservatives :* Preservatives enter into solution in the milk and, therefore, markedly alter the freezing point, the change depending on the nature of the preservative and quantity added. It is therefore desirable that samples to be tested by this method should not contain any preservative, and if at all they have to be stored, they must be kept in a refrigerator. If any preservative has been used its nature and amount should be known so that a correction can be applied for it.

Addition of preservatives and other substances like sugar, even in small quantities, markedly lowers the freezing point of milk. Hence if such foreign substances are added to milk their presence will not go undetected. If along with substances which lower the freezing point, say water is added to counterbalance the effect, such an addition will at once become evident when the sample is tested for the percentage of solids-not-fat and fat by the regular methods in use.

(vii) *Effect of acidity development in milk :* Development of acidity in milk increases the freezing point depression. It is, therefore, essential that samples tested should be wholesome with acidity not exceeding 0·19 per cent lactic acid, and in addition should not give a positive boiling test at the time of testing. If these precautions are not observed, some quantity of added water will go undetected as the developed acidity has a tendency to mask the effect of such addition.

Detecting of adulteration with water

Experiments carried out in the laboratory show that addition of three per cent of water to milk is easily detected when the original freezing point of milk is not known assuming the minimum freezing point of milk to be —0·530°C. Tests carried out for fat and S.N.F. on the same samples of milk revealed the sensitivity of this test. For example a sample of cow milk gave fat 5·5 per cent, S.N.F. 9·47 per cent and freezing point —0·548°C. When adulterated with 10 per cent of water, the respective values were 4·90, 8·52 and —0·489°C. A survey of milk sold in the local market showed that nearly 75 per cent of the samples tested contained added water, though many of these gave normal values for fat and S.N.F. These results will illustrate the utility of the freezing point test for detecting adulteration with water.

It is hoped that the data presented here will help the public health authorities to prescribe this test for quality control work. Though the method is a little time-consuming and costly, it is only by the application of such a method which gives clear cut results, that the evil of adulteration can be successfully wiped out. It may also be added that like every other method the freezing point test has its weaker points, and the test should therefore be used as a supplement to the results of fat and specific gravity, and not to replace any quicker and useful tests.

POWER MAKING DEVICE INVENTED IN AUSTRALIA

IN recent years Australian farmers have invented or adapted a remarkable number of machines and devices to lighten labour or enable farm operations to be carried out more quickly or efficiently. There has been nothing makeshift about these inventions. Many of them have subsequently been accepted by manufacturers for regular production.

One of the latest and simplest of these devices has been designed by Mr. W. H. Tann, who farms at Beech Forest, in Victoria. It is a horizontal metal plate, fitted with a series of vertical tynes. It can be used to replace the blade on a bulldozer, from which it differs as a gardening fork differs from a spade.

In use, the tynes cut through the earth to a depth of 15 inches, and sift out buried objects without carrying away the topsoil. Its most obvious use would be in clearing land of roots after scrub had been burned off, but it might also prove of value in preparing rock-strewn land for cultivation with an ordinary plough.—*Australian Agricultural Newsletter*, No. AGN/254.

BIRDSFOOT TREFOIL

By M. R. PANIKKAR

FODDER problem is as important as food problem, and is considered as a part of the latter in all agriculturally advanced countries of the world. The need for increasing the acreage under fodder crops in India or supplementing the fodder resources has been expressed time and again. At present there are only 304·3 million tons of fodder available as against requirements of 608·5 million tons. The area of cultivated land available per head of bovine population in India is only 1·8 acres, as compared with 3·4 acres in Great Britain, 4·5 acres in New Zealand, 24·9 acres in the U.S.A. and 31·4 acres in Canada. Except for a few seasonal crops grown under irrigation, and which too are not available everywhere, there is no largescale fodder cultivation or pasture development in India. No serious attempts have so far been made to explore and exploit the indigenous sources of fodder and forage plants, nor, barring a few exceptions, for the introduction of suitable exotics.

The scheme for the collection of useful indigenous and exotic plants sanctioned by the Indian Council of Agricultural Research and worked in the Indian Agricultural Research Institute, New Delhi, is however believed to be a prologue for a full-fledged Bureau of Plant Introduction, which is a necessary organization in an agricultural country. Through such an organization it will be possible to procure and introduce into the country many valuable plants which are cultivated for fodder purposes and otherwise in other countries. The Birdsfoot trefoil (*Lotus corniculatus* L.) is one of these plants which is on the list of the Bureau of Plant Introduction. A semi-erect and another spreading varieties of the plant were obtained by the Indian Agricultural Research Institute from South America (Uruguay) and the U.S.A. (Montana) respectively for trial. Sowings were made in October 1948, but the growth of the plants were slow, and in six months they were hardly nine inches high. However, none of these varieties flowered till April 1949, though artificial illumination has since induced it.

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Distribution and characteristics

In this short note it is intended to describe briefly the main points of the plant, about which several enquiries have been received in the Indian Council of Agricultural Research. Strachey[1] noted this yellow flowered herb blooming in April-September at 4,000 to 7,000 feet above the sea-level in the rainy regions of the Himalayas, at Almora, and mentioned that its distribution extends eastwards to China and westwards to Britain. It is also reported as growing wild in the Punjab by Sampson[2]. It is a leguminous fodder plant of temperate regions, but with a wide range of adaptability to varied soil and climatic complexes. It is salt-tolerant and a variety *L. corniculatus* var. *tenuifolius* is reported[3] to have high salt tolerance and can stand high summer temperatures. However it grows in areas with low temperature and abundant rainfall, as well as in warmer climates with lesser rainfall. It is also useful for water-logged soils, particularly the narrow-leaved variety, and at the same time it is a good soil binder and is more drought-resistant than most of the shallow-rooted leguminous fodders. Another advantage with this plant is that it persists and flourishes at lower levels of fertility unlike many other forage legumes, produces good pasturage, alone or in mixtures, and provides fodder for late summer feed and autumn grazing[4].

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1. Strachey, Richard (1906). *Catalogue of the Plants of Kumaon, etc.* Revised and supplemented by J. F. Duthie, p. 42., Lovell Reeve and Co., Ltd., London.
2. Sampson, H. C. (1936). Cultivated Crop Plants of the British Empire and the Anglo-Egyptian Sudan, pp. 105-6. *Kew Bull.* Additional Series 12, H. M. Stationery Office, London.
3. Ayers, A. D. (1948). Salt Tolerance of Birdsfoot trefoil. *Jour. Amer. Soc. Agron.* **40**; 331-34.
4. McKee, Ronald (1948). A General View of the Leguminosae, pp. 711-12. Grass : *The Year Book of Agriculture*, 1948. U.S.A. Department of Agriculture, Washington.

It is a fine-stemmed leafy perennial, somewhat decumbent when growing alone, though fairly upright in thick stands. Leaves are sessile along the stems and have five leaflets varying in shape from linear to oval. Flowers are yellow and showy, borne on long flower stalks which carry several or more characteristic spreading pods resembling birds foot, which gave the name to the plant. The minute seeds scatter readily from pods. The root system of the plant is deep with tap roots and branching laterals.

Cultivation

For the cultivation of the plant, a good and firm seed bed is prepared and seeds are sown at ¼ to ½ inch depth at the rate of 5 lb. of seeds per acre when sown alone, but lesser in mixtures with companion crops. As the stem of the plant is weak, it is desirable to sow it mixed with a strong supporting grass to prevent lodging. At the same time plants offering excessive competition in mixtures, and definitely injurious to the crop, are to be scrupulously avoided. For pastures, this trefoil gives best results when sown with sward-producing grasses like Kentucky blue grass (*Poa pratensis*), Timothy (*Phleum pratense*) and Cocksfoot (*Dactylis glomerata*). However, even where growing conditions are favourable, and good soil preparations are obtained, the use of the companion crops in mixtures retards the seedling development, though their effect can be partly lessened by having a sowing a below-normal rate of the former. This legume is to be supplied at planting time with a special inoculam of symbiotic rhizobia different from that of the common rhizobia[5]. Its response to fertilizers resembles that of other legumes and as with most of them, fertilizers high in phosphate will increase yield and often can be used with advantage.

The plant flowers and fruits within four to five months. Harvesting it for hay is not difficult, but not so for seed. The seed ripens unevenly and shatters easily necessitating great care in handling to prevent its undue loss. Only 50 to 100 lb. of seed can be expected from an acre of the crop. The problem of pests and diseases is not serious, as the plant is not affected by them to any large extent.

Fodder value

Primarily used as a fodder plant, as other trefoils, it has high feeding value both as pasturage as well as for hay. Nitrogen, phosphorus, calcium, lignin and other nutrient contents are comparable to those in lucerne (*Medicago sativa*) for hay and white clover (*Trifolium repens*) for pastures. The cyanophoric properties, though varying, have in no case produced any harmful effects. Hydrocyanic acid poisoning has not been found where stocks are fed on this trefoil[5]. It also compares well in palatability with other legumes of similar nature and stage of maturity. This fodder legume seems to be particularly useful for providing late summer feed, as it remains green in the autumn for several weeks after the other legumes have been seriously injured and defoliated by frost. It is a good soil binder for anti-erosion purposes too. In trials for reclamation of seriously eroded wheat lands in the Andean regions of Venezuela, it is reported[6] to have developed satisfactorily. The deep root system together with laterals, branching profusely in the upper soil zone, appear to give definite advantage to the plant over a wide range of environmental conditions. It is a suitable species for water-logged areas too, and is considered as promising for renovation and maintenance of marginal and submarginal lands[5].

Though slow to establish, and may be seriously injured where unfavourable conditions exist during the sowing time, this trefoil is of special value for fodder because it is deep rooted and there is growth even in late summer. It is more drought-resistant than shallow-rooted legumes like the white clover. On the soils adapted to the cultivation of lucerne, the yield for hay of trefoil is lower than that of lucerne; but it is more persistent and gives higher yield of forage. Its soil lime requirement is less than for lucerne. According to Ayers[3] it compares favourably with alfalfa and appears better adapted to salinity and higher temperature than red, alsike, ladino and strawberry clovers. Unlike red clover (*Trifolium pratense*) which gives higher yield in the first year, but does not persist beyond that period in any appreciable quantity, birdsfoot trefoil persists and continues to

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5. MacDonald, H. A. (1947). Birdsfoot trefoil (*Lotus Corniculatus* L.): Its Characters and Potentialities as Forage. *Memoir* No. **261,** Cornell Universities Agricultural Experimental Station, U. S. A.

6. Rosevere, G. N. (1948). The Grass Lands of Latin America, pp. 198. *Bull.* **36.** I. A. B. Aberystwyth, Great Britain.

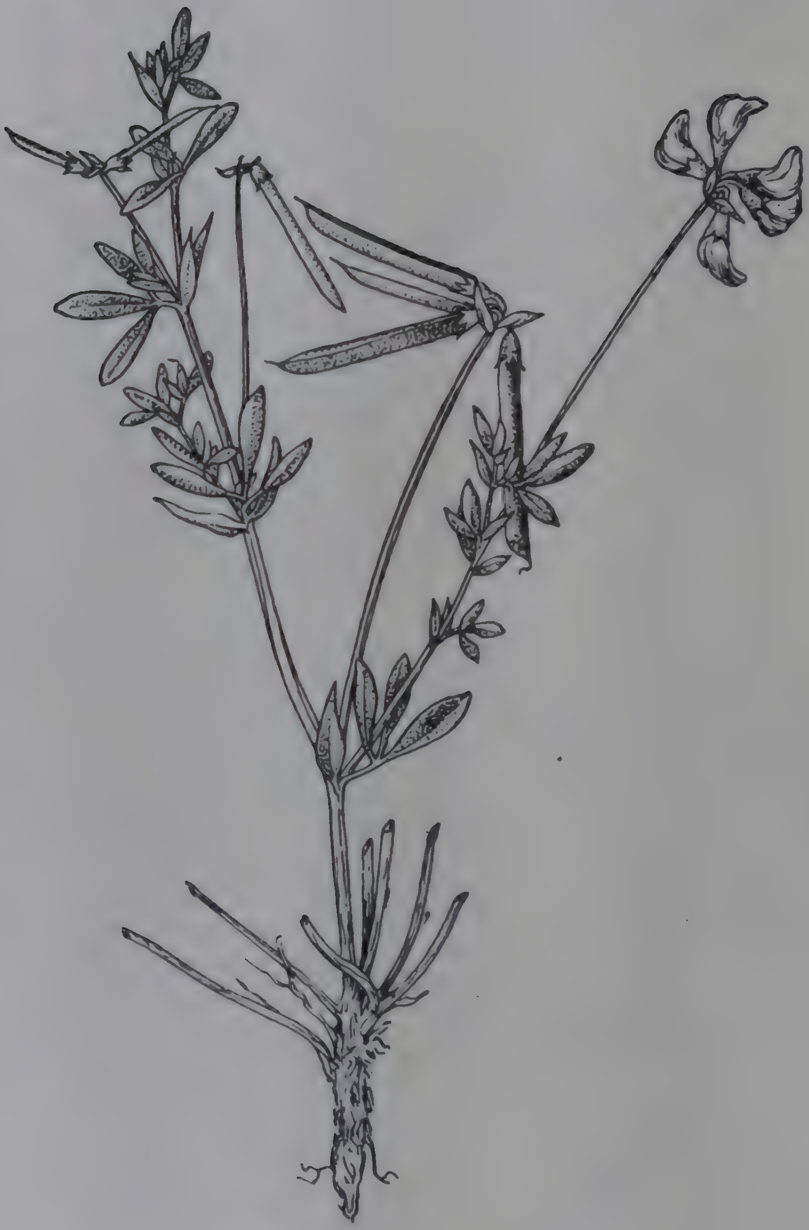

FIG. 1. Birdsfoot trefoil (*Lotus corniculatus*).

produce as a perennial. It also compares favourably with wild white clover. Though it cannot compete with such crops as lucerne or red clover for hay production on better soils, and under short rotation system of farming, it does present possibilities for hay and pasture production on secondary and poorer soils where lucerne is not successful, where red clover is too short-lived for the rotation used and summer conditions too dry for persistence of white clover.

Strains and varieties

Strains of this plant are variable and regional strains developed show marked differences with reference to habit of growth and adaptations. Perhaps these explain the initial unsatisfactory results of the trials with American samples at the Indian Agricultural Research Institute. Indigenous varieties from the Punjab and the United Provinces would, on trial, probably have given a quite different result. Nonetheless, selection and breeding are considered to be two of the most promising means of improving the crop.

There are a few more species under the genus *Lotus*, some of which too seem to have agricultural importance.

(1) *Lotus uliginosus* Schkuhr is the Big trefoil. Its seeds are bigger than those of the Birdsfoot trefoil. The roots have underground root stocks or rhizomes. But it is less winter-hardy, much less salt-tolerant than *L. corniculatus* var. *tenuifolius* and has succeeded only in regions with comparatively milder climate. However, it is widely grown in the wet pastures of South West Australia. In New Zealand it has been found useful in the improvement of marshy or peaty lands where other legumes failed to thrive.

(2) *L. angustissimus* Linn. is of European and North Asian origin and grown as a pasture plant on light swampy soils. It has been successfully introduced in West Australia.

(3) *L. australis* Andr. of Australian origin, is a valuable indigenous forage plant of the dry areas of Australia.

(4) *L. hispidus* Desf. of Europe and North West African origin is grown on lighter swampy soils of West Australia.

(5) *Lotus* sp : Many unspecified species of *Lotus* are of use as green fodder in Malta.

AUSTRALIA CLAIMS WORLD'S PUREST BEES

ACCORDING to Australian apiarists the world's purest bees are at Kangaroo Island, South Australia. They are descended from swarms imported from Italy about 70 years ago and are the only bees of their type left in the world.

The bees were released on their arrival at Kangaroo Island and forgotten until a few years ago. Then the South Australian Department of Agriculture decided to breed them scientifically to retain the strain. Now five apiaries have been established which house about 30,000,000 bees, and a brisk trade has been established for their honey and for export of queen bees to various parts of Australia and to other countries.

Recently, three queens with 25 workers were sent to Egypt packed in small boxes measuring four inches long and half an inch deep. Boxes had three circular compartments which allowed the workers' movement but restricted the queens to the cells in which they were placed. The consignment travelled by ordinary mail and arrived safely.

Kangaroo Island bees are Ligurians and are in demand because they are quieter than the black bee. Slightly longer than the black bee, Ligurians have defined waspish markings.

In Italy, the Ligurian has crossed with other types and the purity of type has been lost.—*Australian Agricultural Newsletter*, No. AGN/254.

WATER CONSERVATION AND FLOOD CONTROL

By P. V. C. RAO

THE United Nations Economic Commission on Asia and the Far East had recently set up a Flood Control Bureau consisting of three to five experts whose business it would be to collect, correlate, and coordinate information and action programmes relating to the flood hazards in the Asian countries. It is also meant to facilitate training and exchange of experts between the various Governments. Its scope of operation is necessarily of an advisory nature on the problem of flood control without taking into account the wider problem of water conservation. It will have to be examined whether such a limited range of approach will help the solution of the problem in any effective manner.

A study of the history of floods would reveal that they are caused mostly by the rapid run-off of the rainfall and snow water at a rate exceeding the carrying capacity of the streams into which the surface waters of the watershed are discharged. When there is an excess of rainfall, the surface soil gets saturated quite soon with the resultant downpour running down the creeks into torrential streams that flood regions all around. In the absence of a cover of growing vegetation or a ground cover of vegetal litter, the rain striking the ground picks up fine particles of the substrata soil to produce a muddy suspension which closes soil pores, thus preventing further infiltration of water. Such premature saturation of soil and the consequent acceleration of the run-off occurs on the lands shorn of the woods and other vegetal cover. Widespread agricultural operations of unprotected fields on hazardous lines help rapid erosion of the porous surface soil and consequent exposure of the hard substrata. Creeks and gullies act with the same menacing force of rapidity as up and down furrows of slopy uplands. The streams gather in momentum while running down the plains with the added strength of the gutterflows. The barren watershed is thus the primary cause of valley floods.

Land under cover of thick vegetal growth retards run-off and retains the optimum storage for slow infiltration by the soil. The vegetal cover also makes the land more cracky and absorptive. The early studies showing the relation of erosion control to flood control was made by George Marsh in the early seventies of the last century. He said in his book *The East as Modified by Human Action*: 'The felling of woods has been attended with momentous consequence to the drainage of the soil, to the external configuration of its surface and probably also to local climate, and the importance of human life as a transforming power is perhaps more clearly demonstrable in the influence man has thus exerted upon superficial geography than in any other result of his material effort'.

It is therefore no exaggeration to conclude that the decline of the Asian nations began with the utter destruction of the primal woods and grass lands. Vast stretches of plains had been stripped off their valuable soils by wind and water erosion and cancerous gullies defaced the entire landscape. Erosion and floods became interacting forces and brought about integrated ruination. The Central Asian plain and the Chinese valleys have been victims of cyclic floods engulfing entire regions. They should curse the past generations for their destructive play with the woods and the grasses.

Even in an advanced country like the U.S.A., efforts of flood control had till recently been confined largely to the construction of louvers, flood walls, flood ways, equalising reservoirs and similar devices in the larger streams. In other words, the main efforts to control floods had been confined to downstream by structures which provide emergency protection from the menacing effects of floods. Regarding the efficacy of such downstream engineering structures alone for the prevention of floods, Mr. Bennett, Head of the U.S.A. Soil Conservation Service, says: 'Flood control programmes to downstream installations do not provide the benefits possible in a more comprehensive attack on the problem, such as undertakes to conserve

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rainfall in fields, pastures, and woodlands over the entire watershed. The purely engineering downstream plan overlooks the possibilities of conserving potential flood waters for useful purposes, on the land ; it fails to consider conservation of the land itself and the necessity of preventing damage to downstream flood control works by the deposition of erosional debris '.

As a result of nationwide investigations conducted by the Water and Power Commission of the American Federal Government, the Omnibus Flood Control Act of 1936 provided for ' investigations of watersheds and measures for run-off and waterflow retardation and soil erosion prevention on watersheds' under the jurisdiction of the Department of Agriculture. Under the provisions of this Act, detailed investigations and surveys should be conducted by this department for the delimitation of the critical areas which are the nerve centres of the run-off streams in the whole watersheds. This involves a plan that provides for the integration of the various action programmes of the Department of Agriculture under the aegis of the Soil Conservation Service, and the employment of structural control measures by the War Department.

The Flood Control Bureau set up by the ECAFE should, therefore, take up under its purview a complete programme of Soil and Water Conservation which would provide not only an effective means of flood control but also scientific agriculture with optimum food output at substained soil fertility, and efficient forest regeneration and maintenance.

TECHNICAL AID FOR UNDER-DEVELOPED COUNTRIES

INDIA'S claim for technical assistance under President Truman's programme of aid to under-developed countries was pressed by the National F.A.O. Liaison Committee in India, at its first meeting held in New Delhi. It recommended that the Indian Delegation to the F.A.O. meeting should emphasize this point, in view of the urgent need for agricultural and industrial development of India. Mr. K. L. Panjabi, Agriculture Secretary, said that the announcement earlier this year by the U.S. President for technical assistance to under-developed countries raised hopes that technical skill and equipment would be available to India for nation-building activities. This matter, he added, was discussed at various meetings of the specialized agencies of the United Nations, namely, the FAO, the ECOSOC, the ILO and the WHO and the impression gathered was that about 35 million dollars would be contributed by the U.S.A. Government for this purpose. But recent information from the ECOSOC, which was the coordinating authority for such aid, indicated that a much smaller amount would be available. Emphasizing India's claim, he said that India did have certain amount of technical knowledge and skill in carrying through nation-building activities but her main difficulty was lack of necessary mechanical equipment ; for example, the ' know how ' of plant protection work was available in India, but the main difficulty was lack of equipment, machines and insecticides to undertake operations on a large scale.

Discussing the International Rice Commission's Report, the Committee recommended that the Indian Delegation should obtain information on advance methods of production in different countries and suggested that exchange of experts would be a useful move in this direction. Provision of irrigation facilities and adequate storage arrangements were particularly emphasized .— *Food Bulletin*, September 19, 1949.

What the Scientists are doing

THE MEDICINAL PLANTS AND FOOD POISONS INQUIRY

A SUMMARY of the main achievements of 'The Medicinal Plants and Food Poisons Inquiry' over which the Indian Council of Agricultural Research has spent about Rs. 1,28,634 during the twelve years of its existence is given below :

This Scheme has definitely advanced the knowledge with regard to the pharmacopoeial and allied drugs growing in India, and in this way has brought them into increased use in the manufacture of preparations used in ordinary medical practice. It has helped to develop the drug manufacturing industry in this country on sound lines, which is the only way in which the masses of India, whose economic condition is low, can get medicinal preparations at prices commensurate with their means. A number of manufacturing firms have come into existence and instead of concentrated extracts which were formerly imported, diluted and bottled, practically every kind of galenical preparation, powders, etc. are now being manufactured in India from materials produced in the country. The growth of pharmaceutical industry has, in its turn, stimulated the manufacture of solvents such as alcohol, chloroform, ether, benzene and many coal-tar products used in medicine.

The demand for indigenous raw material has increased and the area of drug cultivation has increased side by side. Examples of drugs which have been brought into extensive use are belladonna, digitalis, hyoscyamus, squills, colchicum, gentian, artemisia, juniper, velarian, podophyllum, colocynth, ephedra, pyrethrum, etc. Raw materials of good quality are now more easily available at reasonable prices, and the export of crude drugs from India, e.g. belladonna, ephedra, podophyllum, chaulmoogra, castor oil seeds, etc. has considerably increased.

This Scheme has helped actively in the systematic study of the poisonous plants growing in India. This work is of considerable importance not merely from the point of view of medical practice, but also from the point of view of the veterinarian and poisoning of the livestock. It is also of great economic significance. The toxicological aspects of plants in common use such as *Aconitum*, *Barringtonia*, *Calotropis*, *Nerium*, etc. have been worked out and a much needed note of warning against their indiscriminate use by the unqualified indigenous practitioners has been sounded. The survey of this group has been completed and the monographs on the poisonous plants of India will serve as a guide and as a basis for future work to those interested in this field.

This Scheme has investigated some common food poisons of this country such as *khesari dal* (*Lathyrus sativus*), Indian millet (*Sorghum vulgare*), *sialkanta* seeds (*Agremone mexicana*), etc. which have been responsible for producing serious outbreaks of poisoning amongst man and animals. Only fringes of this vast problem have so far been touched ; much important work remains to be done.

A survey of the Indian medicinal plants was carried out and localities of distribution of important medicinal plants such as the pharmacopoeial drugs of vegetable origin and their substitutes growing in India have been worked out. This work will be of value in harnessing the indigenous drug resources of the country.

A herbarium of Indian medicinal and poisonous plants dealing with about 1,800 species and 10,000 sheets has been established. Such a herbarium is essential for proper identification of medicinal plants for purposes of research, and collection for manufacturing purposes.

This Scheme has done much to prove or disprove the therapeutic value of many drugs used in the indigenous medicine by the application of modern methods of chemical, pharmacological and therapeutic research. Of the drugs which have proved useful, the examples of *Adhatoda vasica*, *Plantago ovata*, *Holarrhena antidysenterica*, *Rauwolfia serpentina*, *Psoralea corylifolia*, *Saussurea lapa*, etc. may be cited. These and a number of other drugs which have been sufficiently worked out have been admitted in the Indian Pharmacopoeia List which was recently composed and published by a Committee appointed by the Government of India. This list in the first instance forms an addendum to the British Pharmacopoeia and will serve as a basis for the future Indian Pharmacopoeia. On the other hand a number of drugs which were in the old addendum have been shown worthless and deleted.

The contributions of this Scheme in the field of medicinal plant cultivation are none the less important. India is an emporium of all kinds of medicinal herbs and drugs, and, with suitable opportunities, she could not only meet her own demand but could have a large residue for export. The work has stimulated the cultivation of medicinal plants under suitable conditions of soil, season and climate in order to obtain the maximum quantity of active principles. In this way cultivation of important drugs such as digitalis, ipecacuanha, pyrethrum, etc. has been encouraged.

This work has led to the publication of the Monograph of the Poisonous Plants of India* in two volumes and a very large number of scientific papers. These provide a much needed information about the medicinal and poisonous plants o India.

This Scheme has helped different Provincial Governments, Indian States, agriculturists and private individuals with advice on various aspects of the medicinal plants. It is this work which has given an impetus to research on Indian medicinal plants in many places. Investigations have been started in various universities and colleges, in centres such as Calcutta, Bombay, Dacca, Patna, Allahabad, Lahore, Madras, Trivandrum, etc. The educated people are realizing that the old systems are out of date in many respects, that many drugs used by them are not effective, and that the wholesale revival of them will not be to the best interests of India.

And last, but not the least, it may be emphasized that this Scheme has been instrumental in developing a well-trained personnel for carrying out research of this kind in this country. It should be remembered that the introduction of new medicinal agents from the claims of the indigenous materia medica is not an easy task, and requires close cooperation of botanists, chemists, pharmacologists and clinicians, and such an organization was built up for the first time, after years of patient work. It is a great pity that the Medicinal Plants and Food Poisons Inquiry has now been brought to an end and thus the botanical unit has been dispersed. Although a good deal of basic work on medicinal and poisonous plants has been done under this Scheme, a thorough and comprehensive study of all these plants is the work of many years, perhaps of some generations. It should be remembered that on the one hand that the indigenous system of medicine ministers to the needs of about 80 per cent of the population of this large country and on the other hand, on the poisonous plants side also, the cattle population of India is perhaps the largest of any other country in the world and mortality from this cause is very high at present. (R. N. C.).

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*In the press. Part I is to be released shortly.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. We know of cow-dung being used as a manure in our country. What other organic wastes do you mean which can be converted into manure ?

A. In the villages in addition to cow-dung, cattle urine, crop residues like *jowar*, wheat, paddy stalks, household wastes, kitchen ash, and village refuse matter can be converted into organic manure. In the towns there are large quantities of *katchra*, night-soil, slaughter-house wastes, etc. which by a simple process can be fermented and converted into what is called 'compost' The urban population in India has now increased to about 100 millions. By a proper utilization of the refuse materials, available in nearly 4,223 lakh tons in India, it would be possible to prepare nearly 100 lakh tons of good quality compost which can go to increase our food production by about 150 to 200 lakh maunds per year.

In addition to town refuse plenty of sewage, sullage and sludge at present goes to waste in our cities. The total quantity of sewage produced in those of our towns which are fitted with underground sewage is estimated at about 500 million gallons per day. The sewage is rich in nitrogen and other plant nutrients and the loss under this head alone amounts to an equivalent of 182,500 tons of ammonium sulphate valued at Rs. 5½ crores per year. The above 500 million gallons of sewage per day can bring under irrigation an additional 360,000 acres of land and increase the production by 36 lakh maunds per year.

The Indian Council of Agricultural Research have been carrying on investigations for several years past, with a view to devising suitable methods whereby the above refuse materials could be employed for increasing our food production, without creating any nuisance or danger to public health. As a result of these investigations, satisfactory methods have now been worked out, whereby town refuse could be converted into useful compost resembling farmyard manure in appearance and properties. Sewage could also be used for irrigating land, and increasing food production in such a manner that it does not endanger public health. For this purpose, root-vegetables and low-lying crops, especially those eaten raw, should be avoided, but other crops which are processed and cooked, e.g. cereals, fruits, sugarcane, etc. may be grown with safety. In order to keep the soil in good condition, it would be necessary to fix a proper rotation of crops in the land treated with sewage, e.g. a wet crop like rice or sugarcane or heavy fodder may be grown followed by a comparatively dry crop like *jowar*, *bajra*, maize, etc. followed in some cases by fallow, where the land is on the heavier side.

By introducing properly worked out schemes of compost preparation and sewage irrigation, not only could food production be increased appreciably, but the Municipality can recoup in full the heavy expenditure it has to incur at present for the disposal of its refuse.

In view of the general apathy shown by Municipalities, however, in the matter of converting their refuse into manure, a certain amount of compulsion is necessary in the matter. Legislation to modify the Municipal Act so as to empower Government to compel Municipalities to convert their refuse into compost manure has already been passed in the Central Provinces and Berar and is now under consideration in other provinces like Bombay, East Punjab, Bihar, West Bengal, etc.

At present nearly 700 Municipalities out of a total of 4,000 are preparing compost at the rate of about 750,000 tons per year, but it is expected that during the year 1949-50, the production rate would be nearly doubled. Big cities like Calcutta, Bombay, Madras and Delhi alone can from their several years' accumulated stocks supply nearly one million tons of manure, if proper arrangements for the transport and distribution of the manure by motor trucks and by railway wagons be made.

In order to accelerate the production of compost manure in the country, the Government of India appointed, in March 1948, a special committee known as the Central Manure (Compost) Development Committee with powers to review the progress of compost work in different areas, to prepare fresh schemes for expanding the work and to carry out intensive propaganda to achieve the objects of the Committee. The above Committee held its second meeting at Jaipur in December last during the Congress Week and made a number of recommendations, including one fixing definite targets of increased manure production for each area. In order to carry out the above recommendations of the All-India Committee, Provincial Compost Development Committees have been formed in different parts of the country which have held frequent conferences and meetings and a compost drive has been started throughout the country. It is expected that as a result of this drive, enough manure would become available in the country which would make the country ultimatley self-sufficient in the matter of food*.

***From the summary of a talk given by Sardar Datar Singh from the Delhi Station of All-India Radio on 7 April, 1949. Published with the kind permission of All-India Radio.**

URBAN CLASSES TO HELP IN FOOD PRODUCTION

THE Agriculture Minister in an appeal to the urban residents of Bombay has urged them to help in the food production drive by doing actual work in the fields at least one day in the week. He called upon willing workers to register their names with the appropriate authorities.

The Hon'ble Mr. B. G. Kher, Premier, in a statement endorsed the appeal of the Agriculture Minister and said : ' I consider this to be an excellent opportunity for all young men and women irrespective of their political and other ideologies to bend their energies to this most urgent task before the country.' Mr. Kher added : In a national crisis like the present one, everyone must work and it was only reasonable to expect that the urban population also should contribute their spare time to the production of food in the villages on which they subsisted.—*Food Bulletin,* September 19, 1949.

What's doing in All-India

INCREASED PRODUCTION OF 44 LAKH TONS OF FOODGRAINS

THE Government's four-point plan to increase foodgrains production in India by nearly 44,00,000 tons by the end of 1951, was outlined at a Press conference* addressed by Mr. R. K. Patil, Commissioner of Food Production. Of this additional increase, 36,10,000 tons were to be secured through intensive cultivation, 3,00,000 tons from the reclamation of weed-infested and new lands by means of tractors, 2,60,000 tons through tubewell irrigation and 2,30,000 tons by the diversion of the acreage under sugarcane to foodgrains.

Discussing the reasons for the contradiction between the intentions and the achievements of the 'grow more food' campaign which had been in operation during the last four years, Mr. Patil recognized that the Central and Provincial Governments had to share part of the blame. There had been some increase in this food production during the last few years, but that was a result of the country's general development programme. The 'grow more food' campaign had succeeded to the same extent, as our other development programmes. 'So far there has not been that development of a special will which alone can ensure success in war on the food front. That can only come when there is a definite objective and a clear-out programme, which has to be carried through with vision'. The administrative machinery left by the previous Government was admirably suited for the maintenance of the *status quo*, but it had now to be geared to the new needs of producing sufficient food for the country within the next two years. During this period every other interest and plan had to be subordinated to this single aim. During the last war, despite the passive hostility of the people, the British Government in India did achieve some success in the war effort. If the present food crisis is fought on a war basis, success is assured, for instead of hostility, the Government has the willing support of the country. But for this it is necessary to create an atmosphere of urgency in the urban areas before it can percolate to the villages. If the cultivator is to be enthused for growing more food as a patriotic duty, that duty must be first discharged by those who have a better conception of patriotism than the cultivator. If during the period of the war, high civilian officers and prominent non-officials could be singled out for Government displeasure for not making their contribution to the war effort, there is no reason why men at the top should not be subject to opprobrium, if they fail to make their contribution during this period of national crisis.

Provincial machinery

There will be a sub-committee of the Cabinet in all provinces charged with the responsibility of successfully carrying out the 'grow more food' campaign. It will consist of the Premier and the Provincial Ministers of Finance, Agriculture and Irrigation. Its chief executive officer will be the Director of Food Production, who will be in charge of increasing production, in the same manner as the Commissioner of Food Production is at the Centre.

Measures of intensive cultivation

Intensive cultivation measures will assume the supply of (1) more manure, (2) better seeds and (3) more water for irrigation. One of the reasons for higher yields of crops in the more advanced countries of Europe and America, and even in China and Japan, is the larger application of organic and inorganic manures. There is enormous scope in India for the use of natural organic manure. It is estimated that nitrogen derived from the residents of

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* At New Delhi on 9th August, 1949.

Delhi, for example, is sufficient to fertilize a minimum of 40,000 acres of land. Another rich source of manure is cattle dung and cattle urine. Composting has made some progress in recent years, but even so only 686 municipalities out of a total of 4,000 are working on such schemes, and the total annual production of compost is estimated at 705,300 tons, which is only seven per cent of India's capacity. To grow more food from the soil, more soil food (manure) must go back to it. One of the most important measures in the Government's increased production plan therefore, is to launch a compost drive, both in the urban and rural areas. The problem has an administrative and a psychological aspect. In the first case, various administrative measures will have to be taken to ensure that the whole government machinery is concentrated on this idea, and in the second case, the villager's prejudice against the use of this type of manure will have to be overcome, as has already been done in some municipal areas.

As regards chemical fertilizers, which India is getting from abroad, and is also manufacturing to a limited extent, there is unanimity in the view that their use without a *humus* base of organic manure is disastrous for the soil. As we are having 5,00,000 tons of chemical fertilizers, this is an additional reason for producing our own organic manure as much as possible.

Water for irrigation

The largest single factor responsible for a satisfactory crop is timely and assured water supply. It has been often stated that if India could utilize all its rain water, it would be a land of plenty. The problem is not that the total precipitation of rainfall is insufficient, but that its distribution is uneven and erratic. This problem the Government plans to solve through concentrating on small irrigation schemes of surface wells and tanks, and the bunding of small *nullahs* and tiny streams.

Seeds

India's 59 million acres under rice and 25 million acres under wheat need about 2 million tons of seed paddy and 0·9 million tons of seed wheat. In addition to the existing schemes of distribution of good seed to the cultivators, the Government are examining a scheme of educating the villager to make his own seed selection. This will result in a substantial increase in the crop outturn.

Land reclamation

India is expecting a substantial loan from the International Bank for her schemes of land reclamation by heavy tractors. The target of land reclamation during the next two years is 8,00,000 acres which will bring in an increased production of 3,00,000 tons of foodgrains. During the current year, 100,000 acres of land have already been reclaimed, and the result of the experiment with old machines fully justifies an expansion of the scheme. Not only have the total costs of cultivation been met by the bumper harvests reaped, but there have also been substantial profits.

Production-procurement link

All constituent units have been addressed to enact legislation to bring fallow lands under cultivation and to link up increased production to increased procurement. The Central Government have suggested that at least 60 per cent of the increased production from grow more food must be procured by the respective Governments.

Inducements for increased production are to be offered to villagers on a cooperative as well as on an individual basis.

The areas chosen for increased production are to be concentrated in those districts or parts of districts, where there are facilities for irrigation or which enjoy normal rainfall.

Grants to provinces

The Government of India have reviewed the position governing the assistance by them to the provinces for implementing their development plans, in the context of anti-inflationary measures, the resources available to the Centre in the current and the ensuing years, and in the light of discussions at the recent Provincial Finance Ministers' Conference. They have decided that the grants and loans to the various provinces for expenditure on approved development and 'grow more food' schemes should be as follows :

Province	*Grants* 1949-50 development and 'grow more food' schemes	*Loans* 1949-50
	(Figures in lakhs of rupees)	
Madras ...	5,00	6,00
Bombay	2,27	...
U.P.	5,17	4,00
Bihar	4,00	...
C.P. and Berar ...	1,80	3,00
West Bengal ...	2,70	...
Orissa	1,35	2,00
East Punjab ...	1,50	10,00
Assam	1,25	3,25
Coorg	6	5
	25,10	28,30

They have decided that grants to the provinces should be limited to 50 per cent of the expenditure incurred by the Provincial Governments on development schemes including the 'grow more food' schemes, and certain training schemes approved by the Government of India. But in the case of the provinces of West Bengal, and East Punjab, which have been affected by the partition, and Orissa and Assam, which are relatively less developed, the entire expenditure on approved schemes will, for these two years, be reimbursed, as a special case, subject to the maximum amount indicated above.

Provinces are at liberty to transfer any amount for the development programme to 'grow more food' schemes. Lack of funds cannot therefore be an excuse for a failure of the scheme.

The complaint in the past has been that though a large amount of money was spent on the 'grow more food' campaign, it was not known what it had produced. There were no statistics. We have already strengthened the statistical organization at the Centre and asked the provinces to do likewise.

Subsidiary foods

An essential and important part of food production is subsidiary food. The inportance of this will be appreciated from the fact that from an acre of land, 548 maunds of potatoes can be produced under very favourable conditions, while 25 maunds of wheat can be produced with good irrigation. And the land which can grow irrigated wheat is generally also favourable for growing potatoes. We usually import potato seed from abroad and spend foreign exchange. This can be curtailed, if not completely saved, by growing more potatoes. The same applies to other subsidiary foods.

We also propose to indicate to the people the best way of storing foodgrains so that losses on account of storage are reduced to a minimum.

Crop protection

So far the interests of crop protection have been subordinated to those of preservation of law and order with the result that crop protection has suffered. It will be our purpose to reverse this process now. The first step to secure this will be to see that licences for arms are given freely to cultivators or to their nominees. The latter are frequently persons who are professional *shikaris* or belong to a caste whose ancestral profession is to kill wild animals.

In areas where the damage to crops is serious, special efforts will be made to form crop protection societies on the part of cultivators and they will be provided with fire-arms. Linked with this question of crop protection is the question of catching wild animals, like wild cows, which are rampant in particular areas and damage crops. A method of catching these wild animals is being practised and demonstrated in Mathura District. Arrangements have been made to train provincial candidates at this centre.

All party programme

While the Congress, because of its past history and achievements, has a special responsibility in winding this war against food shortage, it can only be fought to a speedy and successful end by the willing cooperation of all parties in the country. This is a programme in which all Indian parties and interests without the sacrifice of any of their political ideologies, can unite to ward off a common danger.

The question is, shall we, as a nation, rise by each one of us doing his duty in this total war on the food front ? Our slogan is 'Produce More Food', and 'Waste No Food'. I have no doubt, that the task, though difficult, can be successfully accomplished, if the right atmosphere is created. And herein the Press has to play an important part of making the nation fully war-conscious. If that is achieved everything else will follow. (*P.I.B.*)

COCHIN

N. SANKARA MENON

THE 'Kole' and 'Puncha' paddy crops cultivated during the period January-April suffered to a great extent due to the drying up of all sources of water and the complete absence of thunderstorms during the month of March 1949. Of the total area under cultivation, namely about 20,000 acres, normal yield was obtained from only a small portion and the crop completely dried up in certain places. An intensive campaign on manuring these crops was conducted by the officers of the Department and the liberal subsidy of 50 per cent on the selling price of manures granted by the Government induced cultivators to manure their crop on a large scale. The failure of the crop over a large area was a blow to the cultivators in that they lost the amount spent on manuring also. Steps were immediately taken by the Government to prevent the recurrence of such a catastrophe and a conference of cultivators and officials was convened under the chairmanship of the Hon'ble the Prime Minister of the State. The measures to be taken to ensure a satisfactory supply of water to these crops were discussed and action is being taken on the proposals placed before the conference. Water will be stored in suitable places to irrigate the crop in case thunderstorms fail during the growing period.

Subsidy on manures

Since the food situation in the country has not materially improved, the subsidy of 50 per cent sanctioned on the selling price of manures used for 'Puncha' and 'Kole' paddy crops was extended to manures used for the first crop of paddy locally called 'Viruppu.' Vigorous propaganda is conducted to induce all cultivators to manure the 'Viruppu' paddy crop. Rainfall is almost normal and well-distributed and the crop is coming up well. Manuring may show very good effect if the monsoon continues to be favourable.

N. SANKARA MENON, B.A., B.Ag., is Manure Officer, Trichur.

Green manure crop

To induce cultivators to grow green manure on a large scale especially for the paddy crop, a subsidy of 50 per cent on the selling price of green manure seed is sanctioned by the Government. Seeds are distributed on a large scale and it is expected that a large area under paddy will be manured with green manure. The exact quantity of seed distributed can be ascertained only after the season is over. Green manure plants are distributed on a very large scale at a nominal price from the Government Central Farm.

Production of compost

The preparation of this valuable manure in the Municipal areas was taken over by the Agricultural Department and the whole work was put under the charge of a full-time officer. The work is now in progress in five Municipalities and one small town where the sweepings and night-soil are collected by the *Panchayat* and Public Health Department respectively. Only three months have passed since the work was undertaken by the Department and therefore the manure under preparation can be used only after some time. Small quantities which have decomposed satisfactorily are being sold now. The scheme will be extended to the other Municipalities also within a few months and provision for this has been made in the next year's budget.

The Government have also sanctioned the 'Village Compost Scheme' for the preparation of compost in households and farms by utilizing sweepings and cattle dung. A subsidy of one rupee per ton of compost manufactured is sanctioned. The question of giving a subsidy of Rs. 2-8 per 100 c.ft. of trench for preparing the compost is under the consideration of the Government. A large quantity of compost can be prepared in the State if the subsidy mentioned above is sanctioned. The Departmental Officers are making their best efforts to see that all available organic refuse is converted into very valuable manure.

Grow more food schemes

The Cochin Government have under consideration several schemes to make the State as self-sufficient in food as possible and these schemes were discussed at a meeting held at Trichur on 16 May 1949, at which the Hon'ble the Prime Minister of the State presided. The measures included three major irrigation schemes and a few minor irrigation works. The three major irrigation schemes are the Peechi Scheme, the Chalakudi River Diversion Scheme, and the Wadakkancheri River Valley Scheme. The Peechi Scheme is estimated to cost Rs. 150 lakhs. About 12,000 acres of dry land can be converted into wet land for growing paddy. Four thousand acres of single crop land can be converted into double crop paddy lands and the water in the reservoir will be useful for about 10,000 acres of existing paddy lands in case the monsoon fails. The water can be used for the 'Kole' and 'Puncha' paddy also whenever there is necessity for the same. The Chalakudi River Diversion Scheme is estimated to cost Rs. 72 lakhs. When the work is completed, about 11,000 acres of dry land can be converted into paddy lands. Four thousand acres of single crop land can be converted into double crop lands and it can benefit 6,000 acres of existing double crop and 3,000 acres of single crop lands. The Wadakkancheri River Valley Scheme is estimated to cost Rs. 25 lakhs and will bring 5,000 acres of new area into double crop paddy lands besides benefiting 3,500 acres of existing paddy lands.

Besides the above work, it is proposed to clear an area of 25,000 acres in the forest for the cultivation of food crops. A tractor unit is working for this purpose.

Intensive cultivation also is to be taken up to increase the production of food crops and for this purpose, a liberal subsidy will be given on the selling price of manures. The distribution of high yielding strains of paddy will be taken up on a very large scale. Green manure seeds will be procured and distributed at half the cost price. It was also proposed to spend about Rs. 10 lakhs for minor irrigation works.

The above schemes when completed will solve the food problem of the State to a very large extent.

PATIALA AND EAST PUNJAB STATES UNION

RANBIR SINGH

THE Patiala and East Punjab States Union was formed on 20 August, 1948. The staff of the Agricultural Departments of the covenanting States have been integrated, which forms a big unit as compared to that of individual States. The main activities of the Department since the formation of the Union are briefly described below.

Veterinary Department

This Department is under the control of the Director of Agriculture. The Union Government have sanctioned the posts of one Veterinary Superintendent, four Deputy Veterinary Superintendents, 25 Veterinary Assistants with the necessary compounders and other subordinate staff. Funds for medicine to render help to the cattle of the Union have been placed at the disposal of veterinary hospitals at suitable centres. This scheme will go a long way to save the cattle of rural people from epidemics and other contagious diseases. The full complement of staff have been appointed and the work of the Department has commenced.

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Cattle Improvement and Insurance Scheme

This Scheme has been sanctioned in coordination with the Indian Council of Agricultural Research, New Delhi the cost being shared on a 50 : 50 basis. The Scheme is under the charge of Dr Mohinder Singh. The object of the Scheme is to improve the cattle of the villages and to improve the milk supply of Patiala city with insurance against death, etc. The villagers are being advanced money for the purchase of good cattle to begin with, in order to make the Scheme a success.

Land reclamation

A detailed scheme to reclaim about 2 lakh acres of land in the first year has been worked out and sent to the Government of India for raising loan from the World Monetary Fund. The Union Government have purchased six tractors through the Government of India and have issued them to very big landlords in different centres to work on their lands in order to increase the production and give an impetus to the grow more food activities within the Union.

Agricultural development

The posts of Agricultural Botanist and Agricultural Chemist have been sanctioned. A detailed scheme for a research and experimental farm has been prepared for the sanction of the Government. Similarly schemes for improving dairy cattle, for increasing the water supply in the existing wells by boring, and for sinking of tube-wells, etc. have been chalked out and are awaiting the sanction of the Union Government. These schemes are in connection with the 'grow more food' campaign. Some of the schemes are expected to come into operation very soon.

Supply of improved seeds

The Union Government has sanctioned about Rs. 2 lakhs in the current year's budget to meet the increasing demand for improved seeds from the public. This aims at increasing the yield per unit of area of important cereals and other foodgrains. There are great potentialities of agricultural improvements and developments within the Union.

TRAINED PERSONNEL FOR IRRIGATION SCHEMES

'THE crisis is an immediate one and any scheme which provides for food immediately should receive priority over schemes that have a longer range value'. In these words, the Central Ministry of Agriculture has made a suggestion to all provinces and States to divert to the maximum possible extent, the available engineering staff to grow more food work.

Because of the paucity of trained personnel, the provinces have, in the past, found it difficult to implement fully their minor irrigation schemes, which are of great importance in the programme of intensive food production in the provinces. The greatest difficulty is being felt at the level of overseers and supervisors. A few suggestions have been made by the Agriculture Ministry to meet this difficulty to some extent. First, that schemes other than those relating to food production, which need the services of engineering staff, such as roads and building works should have second priority; and secondly, to examine the possibility of arranging with the Universities that the practical training in the Engineering colleges might form part of the work done in the field, so that students could be released after their pre-practical course is over. It is felt that this practical training would be of greater use than that given in the colleges on the pilot scale. The third suggestion is that a six months' course in survey and execution of small works should be started, which would enable candidates to survey, prepare plans and estimates, and undertake the routine execution of small works.—*Food Bulletin*, September 19, 1949.

Across the Borders

DISEASES AFFECTING YOUNG CATTLE

By A. R. GRAYSON

ANY disease affecting young cattle, and resulting either in death or unthriftiness, represents a serious economic loss to both the individual owner and the community. Where death does not occur, the time and labour involved in nursing and treating the sick animal represents a serious drain on the limited labour available. These disease conditions, however, can often be controlled by attention to hygiene, and in some cases disease can be prevented by calfhood immunization. This latter method, in particular, is strongly recommended, representing a direct financial saving, as well as saving of labour.

Scours in calves

White scours: The term 'white scours' indicates the chief symptom of a serious disease in young calves, which is common in the dairy herds of this State. It is a form of diarrhoea occurring usually within two or three weeks after birth, and is due to organisms of the Colon type. Infection usually takes place by way of the mouth, but an unhealed navel may afford a means of entrance. The disease runs a fairly rapid course, and is fatal in a large percentage of cases. In some instances, where recovery does occur, secondary infection, i.e. arthritis, may arise. Surviving animals remain weak and stunted for a considerable time.

Symptoms may occur within a short time after birth, or may not develop for 10 or 12 days. A very profuse liquid diarrhoea is set up, generally yellowish-white in colour, often curdy or frothy, and sometimes blood-stained. The faeces are generally offensive in odour, and their passage is accompanied by straining, grunting or moaning. Emaciation is rapid. The tail region becomes badly soiled, and the calf presents a miserable picture; eyes sunken, belly tucked up, back arched, hair stiff and dry. The temperature is raised early, but as the condition progresses the temperature may become sub-normal, as evidenced by a coldness of the extremities.

Blood scours: In older calves, diarrhoea with foetid blood-stained faeces may develop. This condition is commonly known as 'blood scours' and is due to enteritis caused by bacterial infection. As the condition develops, a picture resembling that described above is presented.

Treatment

Treatment consists first in the isolation of the sick calf to prevent the spread of infection. It should be placed in clean, bright, well-drained and well-ventilated, dry surroundings, or in a sheltered, well-drained yard or paddock. All food should be withheld for one or two days, and a liberal supply of cooled boiled water given every four hours. In some milder cases, this will be sufficient to remove the irritating material causing the diarrhoea, and recovery occurs. In other cases, particularly in older calves, it is advisable to dose with castor oil (1 to 3 oz. according to the size of the calf) in an attempt to remove the irritating material, which often consists of undigested clots of milk. This should be followed with an internal antiseptic. Perhaps the best to use would be formalin, which, besides being an intestinal disinfectant, also prevents bloating. The dose according to size is ½ to 1 teaspoonful given in ½ pint of boiled milk. This can be repeated daily. If the diarrhoea still persists, astringents such as bismuth subnitrate 1 dram, gum arabic 1 dram in boiled milk given three times daily, *or* powdered opium 5 grains, catechu 1 dram, and prepared chalk 1 ounce, given in gruel twice daily, may be administered.

Sulphonamide treatment

Certain members of the sulphanilamide group of drugs are highly efficient in controlling calf scours. In order of preference these are sulphamezathine, sulphamerazine and sulphaguanidine. Of the first two, an initial dose of 2 drams (16 half gramme tablets) per 60 lb. bodyweight is given, followed by a dram (8 half gramme tablets) per 60 lb. bodyweight given once every 24 hours.

The tablets are first crushed, and the resulting powder may be incorporated with the food or be given as an electuary with treacle or honey.

Sulphaguanidine for veterinary use is prepared commercially as a pink powder. The initial dose for calves is 3½ grammes (1 level teaspoon and a half) per 50 lb. bodyweight, followed by 2½ grammes (1 level teaspoon) per 50 lb. bodyweight, then 2 grammes at 6-hourly intervals until the scouring subsides.

With any treatment, it is important that the patient have access to an adequate clean water supply.

Prevention

Prevention, however, provides a much better line of defence than does curative treatment, and is more likely to yield better results. It consists in the first place in care and attention at the actual time of calving. In this respect, under Australian conditions, good clean pasture will provide the necessary hygienic surroundings.

On properties where the disease is known to exist, the navel of the calf should be ligatured and disinfected with tincture of iodine at birth or as soon after as possible. The most important line of control, however, is the care which must be given to the nutrition of the newly-born calf. It requires, and should get, its own mother's milk for at least the first few days. This first milk or colostrum has laxative properties, and, in addition, contains elements which assist the calf in resisting disease during its early life. Not the least important of these elements is the relatively high vitamin A content. Whole milk should be fed for the next few weeks. Separated milk should not be fed to the calf until it is three to four weeks old. The change from new to separated milk should be gradual, and a substitute for the cream removed by the separator should be provided. For this purpose 1 to 2 oz. daily of pure cod liver oil is probably the best. If cod liver oil is not obtainable the use of Apsolene or other similar fishliver product will prove satisfactory. The calf should not be overfed, and all milk should be fed at blood heat. More care in the frequency and amount of the feeds will do much to prevent digestive disorders. All feeding buckets should be scalded after each meal and preferably hung up in the open, exposed to sunlight.

The newly-born calf is susceptible to cold, and this necessitates the provision of adequate shelter. This usually takes the form of more or less permanent calf sheds and pens.

Essential points to be considered in the construction of calf sheds are :

1. They should be bright, airy and dry.
2. An impervious floor is essential, and the floor must be given sufficient fall for drainage. Disinfection and general cleanliness are thus rendered easier.
3. Plenty of bedding to provide a warm, dry bed in winter and a cool one in summer should be provided, and soiled bedding must be replaced regularly and frequently.

Calf pens or yards should be sufficiently roomy to provide plenty of exercise. They must be located so that they are not contaminated by drainage from other paddocks or existing sheds, i.e. cow sheds, pig sties, etc. The provision of a feeding rack to contain good quality meadow hay is desirable as this will tend to obviate any tendency to eat bedding. There should be a readily accessible supply of good fresh water.

Minerals are necessary for all growing animals, and milk alone, particularly when separated, does not contain a sufficiency of minerals for normal growth and development. To a large extent any mineral deficiency is overcome when the calf starts feeding on pasture, and this will be further aided by the provision of a suitable mineral lick such as dicalcic phosphate, bonemeal or bone flour 1 part to salt 4 parts. While being bucket fed, the addition of limewater to the milk at the rate of 1 dessertspoonful to 1 quart is of distinct advantage. Carron oil, which is made by mixing equal parts of limewater and raw linseed oil, may also be used.

It must be stressed that calves are born healthy, and that the relatively high rate of mortality is due, fundamentally, to errors in feeding and management, and, as such, are preventable. This particularly applies to 'scours' for outbreaks are intensified under conditions of bad management.

Ringworm in calves

Ringworm is a disease of the skin which may attack any domesticated animal, and also man. It is most frequently seen in young animals such as calves or yearlings which are in poor condition. The disease is contagious, and is caused by fungi of the family *Trichophyta*. These fungi consist of growing threads or hyphae, and have the powers of forming spores which are very resistant and may retain their power of germination for months.

Infection results usually from direct contact of healthy with affected animals, or it may occur in sheds or pastures through the medium of posts, etc. against which affected animals have rubbed themselves.

Lesions most commonly occur about the head, face and lips, eyelids and neck, although they may be found on any part of the body. The lesion commences as a raised ring-like patch on which the hair becomes at first erect, and later breaks off. This is due to the fungus becoming established at the base of the hairs. As a result of its penetration, epithelial scales become heaped up to form greyish-white or greyish-yellow crusts. The lesions are usually numerous and extend to the size of a five-shilling piece. They may become confluent, in which case quite large areas are involved. These crusts are at first firmly adherent, and, if forcibly removed leaves a raw bleeding surface. If left alone, the crust becomes raised by a slight purulent discharge, and may later be shed. The bare skin then exposed has a thickened and wrinkled appearance. The discharge on the bare patch often dries and forms a thin scab under which healing takes place, followed by a subsequent growth of new hair.

In adult cattle there is, as a rule, no systemic disturbance, but in badly affected young stock, general unthriftiness is set up. The degree of irritation is variable, but in the majority of cases calves tend to rub themselves against gate posts and other obstacles, and thus set up centres of infection and re-infection. So, through lack of attention, ringworm may assume a chronic character.

Affected animals should be isolated. Calf pens, etc. from which affected animals have been taken should be thoroughly disinfected, particular attention being paid to the woodwork. Lime-wash containing carbolic acid, ½ pint to the gallon, may be used, and is most effective if applied hot.

Curative treatment in most cases is both simple and effective. The hair should be clipped from around the affected parts, and the crusts and scales removed. This may be done more easily if they are first softened by applications of olive oil. They may then be washed off with warm soapy water to which washing soda has been added. All debris removed should be carefully burnt.

Having cleaned up the affected parts and dried them, the lesions must be dressed with a parasiticide, of which there is a considerable choice. Probably ordinary weak tincture of iodine (2½ per cent) makes the best dressing. Other suitable dressings are equal parts of sulphurous acid and glycerine ; 1 part creosote to 7 parts raw linseed oil ; 2 per cent solution of formalin in water. Mercuric preparations such as mercuric ointment or corrosive sublimate are also very effective. These should not, however, be applied over large areas as calves are liable to be poisoned by mercury. Whatever method of treatment is adopted, it is important to remember—

1. That all diseased hair must first be shed or removed.
2. That a liberal diet is necessary.
3. That man can contract this disease from cattle. The attendant, therefore, should wear overalls while dressing an animal, and should disinfect his hands and arms afterwards.

Blackleg in cattle

Blackleg is an acute infectious disease affecting, chiefly, cattle between the ages of six months and two years. Younger and older cattle, however, may be affected; and sheep of all ages are also susceptible. The disease is more or less restricted to certain well-defined areas. Even in these areas the infection may be restricted to certain portions or even paddocks. River flats, low-lying pastures or swamps, etc. are often particularly dangerous.

Blackleg is caused by a bacillus—*Clostridium chauvei*—which is an anaerobe ; that is, it cannot exist in the presence of oxygen. The bacillus has the power of forming spores and these spores can remain viable for years. Contamination of pastures is greatly increased when infected carcasses are cut up or are not properly disposed of.

Animals do not infect each other directly, but pick up the infection from the soil, either by swallowing infected food or water, or by contamination of a wound.

Symptoms

The period of incubation is usually about three days, and the disease runs a rapid course, death ensuing in from 12 to 48 hours. In many cases, no symptoms are noticed, the infected animal being found dead. When symptoms are seen, a sick animal often shows a lameness generally restricted to one hind leg. The animal separates itself from the rest of the herd, refuses to feed, and rumination ceases. The temperature is raised, being from 104 to 107 degrees, and the animal goes down. There is a blowing respiration often accompanied by grunting. On close inspection, a local swelling may be discovered most often in the upper part of the hind limb in which lameness was apparent. This swelling, however, may appear wherever there is a muscular mass, i.e. in shoulders, loins, chest, neck, etc. It is at first small, hot and painful, but rapidly extends, involving a larger area. Later the swelling becomes cold and insensitive. The skin in the area becomes hard and dry, and there is often a sharp line of demarcation between the diseased and healthy tissues. On manipulation, the swelling is found to be gas-filled and a peculiar crackling sound like the rustling of stiff paper is heard. This is due to the presence of gas in the swelling, the gas being formed in the tissues by causal bacillus. As the condition progresses, the breathing becomes more laboured, the animal becomes prostrate, the temperature falls to normal or sub-normal and death soon follows.

Post-mortem lesions

The characteristic lesion of blackleg is the gas-filled swelling which crackles on manipulation. If the lesion is cut, the muscles and other tissues are found to be dark red or black in colour, and more or less porous and dry-looking. This is due to the separation of the muscle fibres by the gas formation. The affected tissues give off a characteristic odour resembling rancid butter. A blood-stained discharge is given off when the muscle fibres are cut, and sometimes there are similar discharges in the pleural and abdominal cavities.

The frequent occurrence of the swelling in the upper portion of a limb has given to the disease the name 'Blackleg' or 'Black Quarter'. Occasionally, however, no external evidence of swelling is noticed, the lesion in these cases being found elsewhere in the carcass.

Treatment and prevention

Curative treatment is useless. Any attempt at such, by incision of the affected portion and the application of strong disinfectants, is to be condemned because of the certainty of spreading organisms which are very abundant in the liquid escaping from the cut surfaces.

As the spores of the organism can live in the soil, great care must be taken, as already indicated, to prevent any addition to the number already in the soil. Carcasses should not be skinned or unnecessarily cut up, but should be disposed of by complete burning. Cattle of susceptible age should be kept off known infected pastures and periodical burning of these infected pastures is a further method of prevention.

Vaccination

The only effective method of preventing the disease is by vaccinating calves before they reach the susceptible age, and the Commonwealth Serum Laboratories prepare a vaccine which is recommended for this purpose. It contains no living organisms, therefore it is quite safe, and it confers an immunity which persists during the susceptible period. A permit to obtain the vaccine will be supplied on application to the stock inspector of the district, and the inoculation, which consists of the injection of the vaccine (under the skin) can be carried out by the farmer himself. The usual precaution of clipping the hair and sterilizing the skin with tincture of iodine or methylated spirits before injection should be observed. The incoulation is made usually behind the shoulder.

A suitable hypodermic syringe and needle, with care, will last for years, so that the only expense each year is the cost of the vaccine itself.

Blackleg is a notifiable disease under the Stock Disease Act, and all outbreaks should be reported to the Chief Veterinary Inspector, Department of Agriculture, Melbourne, C.2.

All sudden deaths among young cattle, associated with lameness and the characteristic crackling swelling in the muscles of the limbs should cause stockowners to suspect blackleg. In suspicious cases, in order that the diagnosis may be confirmed, a portion of the affected muscle—about 2 inches in diameter—should be placed in a screw-top jar, and this, securely packed, forwarded to the Director, Veterinary Research Institute, Parkville, N.2. A letter advising the despatch of the specimen for diagnosis and describing symptoms noticed, should be forwarded at the same time.—Reproduced from *The Journal of the Department of Agricluture*, Victoria, May, 1949.

COLD STORAGE FACILITIES INCREASE

ONE of the methods which is being actively encouraged by the Ministry of Agriculture to prevent wastage in foodgrains, seeds and other perishable food is the provision of refrigeration facilities and assistance is being given to private enterprise to set up cold storage plants in different parts of the country.

As a result of assistance given during the last two years the number of cold storages in the country has risen from a bare dozen in 1947 to about 50 during this summer season, with a capacity of 500 tons each. With the intensification of the Grow More Food drive, greater assistance is to be given and it is hoped that by the summer of 1950 the country will have about 100 well-equipped storages with a total capacity of storing about 12 lakh maunds of perishable food and seeds. The actual quantity stored in these units will, however, be many times more, as throughout the year there will be a turnover of stocks by the growers and traders in foodstuffs.

Central assistance to commercial firms in setting up cold storages includes technical assistance and guidance about the type of refrigeration units suitable to a particular area, the best method of working the plants and help in making available equipment and machinery required for the industry. Private enterprise has so far invested about five crores of rupees in the industry for building about 100 cold storages by 1950, of which 50 are already in operation.

In view of the importance of potatoes in augmenting the food supply, special preference has been given to the storage of seed potatoes in these units. Some of the units are also utilized for the storing of fish, while there are a few of a multi-purpose nature, located in big consuming areas or at ports like Calcutta, Madras, Bombay.

The largest number of cold storages is located in the important potato belt of the Gangetic plain. The United Provinces alone propose to build 43 units. Plants are also proposed to be set up in Delhi, East Punjab, Central Provinces, West Bengal, Bombay, Mardas, Ajmer-Merwara and Saurashtra.—*P.I.B.*

SCOPE FOR THE MECHANIZATION OF AGRICULTURAL PLOUGHING IN INDIA

CONDITIONS of agriculture in India are very different from those in America or Western countries. The tropical sun; the teeming population; the tiny holdings of the average cultivator; the concentration of rains in a small period of the year with its practical absence in the rest of the period; the relative hardness of the soil; the long period the lands have been under cultivation without sufficient manure necessary for their recoupment; and the absence of machine-mindedness on the part of the agricultural population,—all these factors present problems different from those of Western industrial countries. Any power-operated machinery that is introduced into this country has, therefore, to take into account the peculiar conditions above referred to and the machinery has to be specially designed to suit those conditions.

Practically all the food crops in use in this country are of three to five months growth and require water to mature. Except in irrigated lands which form but a fraction of the total area under cultivation, the crops have to be grown and matured only in the rainy season when the land will be soft enough for tilling and the ground will have retained sufficient moisture to bring the crops to maturity.

The rainy season in most parts of the country lasts only for three to four months but over large areas, the rain waters are collected in ponds or tanks capable of holding water for three or four months longer and irrigating the lands below them for this extended period. It is thus essential that the whole cultivation, from tilling the soil to the maturing of crops, should be completed within the short rainy season or before the tanks get dry.

To accomplish this, it is necessary that all lands should be tilled and seeds sown within a week or ten days after the first monsoon rains, so that before the end of the rainy season the crops will reach maturity. This need is well understood throughout India. It will be seen in every agricultural village that as soon as there is a heavy shower of rain, every ryot is on his field ploughing the land. It is in order to have this simultaneous ploughing that every agriculturist maintains a sufficient number of plough cattle so that he can have his lands ploughed and seeds sown within a week or 10 days after the first rains.

Any machine that is brought to this country should therefore satisfy this fundamental condition. Secondly, there will be no road or trackway to the fields and the plough should be light enough or the heavy parts readily detachable so as to be capable of being carried by a few men to the field and assembled in a few minutes for use. Thirdly, the cost should be such that a small cultivator having about 15 to 20 acres or a small group of cultivators of like area can afford to get a mechanical plough and till the whole of their 15 to 20 acres within a period of about 10 days.

The plough to be brought into extensive use in India should, therefore, satisfy the following requirements:

(1) It should be light or have heavy parts detachable so as to be capable of being carried to the field by three or four men and there assembled in a few minutes.

(2) It should be of low cost so that the small agriculturist owning 15 to 20 acres can own one. The aim should be to make the machine available to the agriculturist at a cost not exceeding Rs. 1,000 each.

(3) It should be of a capacity to till about 1½ to 2 acres in a day of say 8 to 10 hours working.

(4) The owner-cultivator should be able to operate it.

(5) The machine should not be complicated but easy to manipulate and should have all

spare parts readily available.

(6) The power unit should be detachable or made available for use for other work such as pumping, cottage industries and garden cultivation, etc. when the plough is not in use.

(7) The frame and wheels may, if necessary, be of timber strengthened by steel plates so that the machines can be made cheaply and repairs can be effected by country carpenters and smiths.

If Indian engineers set to work to design a unit to satisfy the above conditions, it can easily be accomplished. Such a machine will soon become very popular and come into extensive use in a short time especially now when plough cattle are very costly and in short supply. An agriculturist cultivating 15 to 20 acres requires at present from four to five pairs of cattle which at present day costs cannot be got for less than about Rs. 750 even for low grade animals. The agriculturist will not therefore grudge to invest a little more in securing a reliable mechanical plough.

The better tillage and timely work got from the machine will enable him to get a greater yield from his lands and this will go a long way towards securing to the country self-sufficiency in food production. The agriculturist will be freed from the necessity to maintain a large herd of half-starved plough cattle of low vitality and, with the saving thus effected in his fodder resources, he will be able to maintain milch and drought cattle, feed them well and secure adequate milk supply to the people and, in course of time, even improve the cattle breed.

It is often erroneously thought in villages that these plough cattle are necessary for getting manure. This is a fallacy. We can secure the same manure and in addition get our essential milk supply by utilizing the fodder resources on milch and a better breed of drought cattle.

The manufacture of the simple plough above described in this country will be quite easy. For some time, possibly, a light power unit of six to eight H.P. say of the J.A.P. or other light type engine and a worm type reduction gear may have to be imported but the other parts can easily be manufactured in this country in any fair sized workshop.

The Government can help a good deal by getting power units and reduction gear of a standard size on a large scale and supplying them to workshops at actual cost for building the ploughs, charging a fair price for the machines. If serious attempts are made it should be quite possible to produce the ploughs in about six months time and at the cost above suggested.

Where electricity is available in villages, as in some parts of Madras, agriculturists have already taken to pumping from wells on a mass scale for cultivation. In these cases a plough, making use of the available electric motor and currents, would be very helpful but a suitable design would have to be evolved and the machine produced and made available to the agriculturist.

The educative value of such machinery to the agriculturist, the impetus the machines will give to the educated class to take to productive labour instead of looking to clerical work as their sole aim, and the secondary lucrative occupation which they will give to the agriculturist, will all raise the standard of living in the villages and tend to put a stop to the migration of villagers to towns and even promote a tendency in the opposite direction.

Alertness, regular working hours, discipline, aptitude for physical work and many more good habits which tend to increase production and make a nation great, are the accompanying factors when the mass of people become machine-minded. Nothing in this agricultural country will foster this as small machines of the type described distributed throughout the country.

Large tractors of the type now being imported are useful in country only when large areas of fallow lands are to be brought under cultivation and deep ploughing is required to root out weeds. They require large initial outlay, costly operators and, as working period will be short, they have to be kept idle for the great part of the year thereby adding to the overhead charges. Further, for raising good crops in lands already under cultivation, deep ploughing is unnecessary and may even do positive harm. Large-sized tractors intended for deep ploughing are not required for such lands and hence are not likely to become as popular as small machines.

Introduction of the small machinery as above described on a mass scale will also bring opportunities for subsidiary occupation on a large scale in the villages and thus raise the overall standard of living of the masses.—Reproduced from *Transport-Communications*, May, 1949.

Book Reviews

THE INDIAN SUGAR INDUSTRY (1947-48 ANNUAL)

Edited by M. P. GANDHI (Gandhi & Co., Jan Mansion, Sir Pherozeshah Mehta Road, Fort Bombay, pp. 136, Rs. 6).

THE Annual like its previous numbers is a comprehensive reference book on matters pertaining to the sugar industry of India. It contains a chapter devoted to the various statistics of the sugar industry, a chapter containing a review of the industry during 1947-48 and a chapter bringing to the forefront the main problems of the industry and suggestions for its future development. Shri Gandhi deserves credit for collecting all the statistics from their various sources of issue so expeditiously and for compiling them in the lucid manner in which they have been presented in the book.

The review of the sugar industry for 1947-48 has been made in the context of political and economic conditions prevailing in India during 1947-48 and the prospect of production for 1948-49 has been based on the trends of public and official thought manifesting itself a few weeks prior to the start of the crushing season 1948-49. The question of sugar and sugarcane prices has therefore received due attention and Shri Gandhi has expressed his own views rather boldly on the controversial points regarding 'High Profits to Factories in 1948' and 'Misapprehensions About High Sugar Prices Following Decontrol'. In the reference to the question of export of sugar from India to countries of the Middle East, Pakistan, Celyon and Burma, the desirability of establishing an export trade and the necessity for bringing down the level of sugar price to about Rs. 26 per maund for the purpose, has been rightly stressed.

The question of withdrawing or continuing the protection granted to the sugar industry in 1932, which is now under the consideration of the Tariff Board has been discussed at some length and it has been brought out that the present time being abnormal is inopportune for any inquiry into the question and that protection must be continued for another period of five years ending 31 March, 1954.

The chapter on 'Main Problems of the Industry' appropriately starts with the para entitled 'Agricultural Improvement Needed'. While discussing the agricultural aspect of cane growing, Shri Gandhi states 'From the above discussion it will be conceded that the improved varieties of cane with more vigorous growth and higher tonnage would naturally call for higher soil fertility, better cultivation and more solid moisture than the indigenous cane. The best use of the potentialities of these new varieties of cane can, therefore, be made only by the application to the soil of sufficient quantities of organic manures and artificial fertilizers of the correct type ensuring thereby adequate supplies of nutrients to the growing plant. The higher metabolism of the plant also requires more frequent and larger quantities of irrigation water. These two essential factors in successful cultivation of sugarcane and the value of better tillage and suitable rotations along with the desirability or otherwise of taking one or more ratoon crops in the same field, have not unfortunately received the attention which is due, at the hands of the average cultivator. The consequence has been that the spectacular yields secured originally from the more improved varieties cannot be maintained from year to year, and a rapid decline in growth and yield consequently follows!' Indeed the above is the crux of the whole problem. The chapter includes a few pages on 'World Sugar Production' which has added to the value of the book.

It is satisfactory to note that on the whole due emphasis has been laid on the important problems of the industry such as need for reducing the high level of sugar and sugarcane prices prevailing during the year, the need for an all out drive for increasing the yield of sugar per acre by development and research on sugarcane, the need for continuing protection to the industry, the need for a common Central Sugar Sales Organization, the need for developing palm-sugar production, the necessity of improving *gur* production from sugarcane and last but not the least the need for intensification of Agricultural and Technological Research under the auspices of the Indian Central Sugarcane Committee by restoring to it the research grant recommended by the Tariff Board and agreed to by the Government of India in 1947. (S.C.R.)

* * *

FARM ACCOUNTS

By E. Sewell Bray and C. V. Dawe (Oxford University Press, London, 1948, pp. 103, 15s. net).

THE book is divided into four chapters. The first chapter deals with Farm Accounts. The Farm Account Book devised by the Department of Agricultural Economics, University of Bristol, has been recommended and the various forms for keeping records have been set out in detail in Appendix I. The accounts dealt with in this chapter are mainly kept for the assessment of income tax and enable one to determine the general financial position for the year. They do not permit the calculation of the cost of production of various farm products. For this purpose cost accounts are needed. These are discussed in the second chapter. Under this system the bulk costs are allocated in a systematic manner over the various branches of the farm where these were incurred. The various forms required for this purpose and the method of filling them have been detailed. The third chapter is a discussion of the purposes to which financial and cost account data can be put for economic purposes, such as the study of markets and marketing processes, land economics and utilization, agricultural labour and wages, prices and price variation. Besides this, accounts are of great value in dealing with the day to day problems of farm management with the help and guidance of an economist. The fourth chapter deals with the relationship of professional accountant with the farmer.

In view of the introduction of controls on the various agricultural products, the move to charge the land revenue on income-tax basis, the agitation for the equitable distribution of produce between the tenant and the landlord and for determination of compensation for abolishing zamindari, it is very essential that reliable and accurate farm account be kept. Unfortunately much work in this line has not been done in India. The book under review will, therefore, provide the farmer, the economist and the administrator all the guidance they require in preparing clear and simple accounts of all operations. (K.S.).

* * *

THE INDIAN COTTON TEXTILE INDUSTRY (1947-48 ANNUAL)

Edited by M. P. Gandhi (Gandhi & Co., Jan Mansion, Sir Pherozeshah Mehta Road, Fort, Bombay, Rs. 6).

THE developments connected with the various aspects of the Indian Cotton Textile Industry during 1947-48 have been comprehensively dealt with in this Annual. Several constructive suggestions have been made while discussing the present position and future prospects of the industry. The necessity of a larger expenditure on research and extension work for improving the quality and increasing the quantity of raw cotton production in India, particularly in the light of the effects of the partition of the country, has been stressed in the Appendix relating to raw cotton. This is an issue which cannot be emphasized too often in view of its importance to the national economy of the country.

Besides useful statistical data which are presented separately to give an idea of the industry at a glance, the Annual contains the texts of important control orders and up-to-date lists of cotton mills in India and Pakistan. The usual Appendix on the handloom weaving industry has been revised and enlarged. (K.S.).

FIGHTING THE FODDER FAMINE IN GUJERAT

WITH the onset of the monsoon in Gujerat came the end of what was undoubtedly an unprecedented fodder famine which affected Cutch and Saurashtra, as a result of the failure of the monsoon last year. Famine conditions prevailed over 220,000 square miles, an area twice as large as undivided Bengal and having a cattle population of 5,70,000. And yet because of the timely assistance rendered, and the willing cooperation between the official and non-official agencies and between the various Governments, there was no loss of human life and only a small number of cattle were lost.

The conquest of famine in Cutch and Saurashtra represents not only a triumph of non-official and official efforts, but also an alert organization and careful planning. Gujerat is a cattle-breeding area famous for its Gir and Kankraj breeds of cows and the Surti, Mehsana and Jaffari buffaloes. Had the full resources of the Government not been mobilized in time, a disaster of the greatest magnitude would have affected Western India.

During January reports came in of Cutch being in the grip of an acute fodder famine. Thousands of lean, unfed, neglected and abandoned cattle of well-known breeds like Tharparkar, Red Sindhi and Kankraj roamed in the interior. No fodder was available, and even the trees had been stripped bare of their leaves. Their very barks had been torn off to feed the cattle, many of whom lay dying or dead. The problem brooked no delay, and Sardar Datar Singh, Additional Secretary, Ministry of Agriculture, Government of India, was put in charge of the relief operations. He visited Bhuj and put into effect measures for immediate relief. Officials and non-officials, the Famine Commissioner and members of the Cutch Famine Relief Committee and of the local *pinjrapoles*, united in one common endeavour to save the cattle. Ten thousand tons of hay were immediately purchased from the Central Provinces and the procurement of fodder had begun in other areas. It was essential to move these stocks to Cutch without delay, and start the work of internal distribution. It was decided that abandoned cattle were to be collected in *pinjrapoles* which would also serve as distribution centres for fodder.

Relief plan

These measures were followed up in Delhi by a detailed relief plan and the Central Ministry of Agriculture made available the necessary personnel to put it into execution. It was agreed to move out of Cutch the unproductive cattle so as to relieve the pressure on fodder supplies and to make available concentrates to the *Rabaris* and *Bharvads*, the nomadic cattle breeders, at reasonable prices in the form of takavi loans against security. A Veterinary Officer with four assistants and first-aid equipment was sent to Bhuj to start relief operations immediately as no Veterinary Department existed in Cutch. Grants to local *pinjrapoles* in Cutch which had been discontinued, were revived, and in some cases increased, to encourage these institutions to collect and maintain the abandoned cattle. Remission of revenue on green fodder was allowed. Meanwhile, negotiations had been concluded for purchasing 3,90,000 maunds of grass from Madras and Bhopal making a total of seven lakh maunds secured within a few days.

Transport difficulties

Other difficulties had still to be overcome. The hay purchased was loose. The suppliers had neither baling presses nor baling wires. When these were secured, transport had to be arranged for their despatch to the places where they were required. The main problem was to despatch the hay to Cutch quickly. It was possible to move it to Bombay, but sea transport had to be arranged to ports in Cutch. Shipping companies were reluctant to accept consignments of hay because of the risk of fire, and the freight by country craft was prohibitive. At this critical period an Indian steamship company offered three ships free of cost to move the fodder to Cutch. Such a spirit of cooperation is infectious, and the railway authorities made special arrangements for regular movements to Bombay so as to provide cargo for the steamers in time.

Supply of concentrates

Fodder had been secured in adequate quantities. There was now urgent need to supply concentrates at reasonable prices. The people were willing to buy them. If, therefore, sufficient quantities of concentrates could be made available, the quantity of fodder required could be substantially reduced. This would mean a considerable saving in Government expenditure as the distribution of fodder was being subsidized.

The surplus areas for groundnut cakes and cottonseeds are Bombay, Central Provinces and the Hyderabad State. The first two Provinces supplied each 2,000 tons of groundnut cake and Hyderabad offered an equal quantity of cottonseeds—all at controlled rates. Loans of concentrates free of interest were given to nomadic breeders against securities.

The scheme worked satisfactorily. Ample stocks of fodder and concentrates were available at nine main depots and 67 supply centres of distribution. In addition, 17 *gowshalas* and 81 centres were providing facilities for abandoned cattle. There was general satisfaction over the supply and distribution of cattle feeds. The nomadic breeders utilized to the full, the loan facilities given to them which resulted in a considerable improvement of the condition of their animals. The rate of cattle mortality registered a sharp decline and the production of *ghee* increased.

Famine in Saurashtra

Just when Cutch had turned the corner reports began to pour in of a fodder famine in Saurashtra. It was immediately decided to coordinate the procurement and movement of fodder both for Saurashtra and Cutch. This work was also entrusted to Sardar Datar Singh who had already taken a leading part in fighting the fodder famine in Cutch.

All fodder which had been secured for either Saurashtra or Cutch was pooled, and a decision was reached in consultation with the Governments concerned, about the distribution of the supplies between the two affected areas. The position of hay stocks indicated that a total quantity of about 75,000 bales would be available during the months of May and June. But it was no longer possible to move all the fodder by the combined rail and sea route. It was arranged to send as large quantities as possible by rail, and the balance was to be moved by the combined rail and sea route.

Fodder movement

During a single week 10 special trains left Madhyabharat for Navalakhi carrying about 6,000 bales of hay. In addition, fodder also moved in a large number of wagons from other areas in Madhyabharat. During the same period a steamship load of fodder reached Bhavnagar from Bombay. To resolve the congestion of traffic, which resulted from the rapid movements of fodder from a number of centres, a dump was created at Viramgam for stocking consignments which could not be transported immediately. During this period fresh stocks of about 90,000 maunds of hay were located, and the Saurashtra Government was advised to procure it. To ensure that the steamers at Bombay carried full cargo loads, ready stocks from all stations in the supplying areas were rushed to Bombay by special trains as far as possible, and three steamers were able to carry about 23,000 bales to Bhavnagar in a week's time. In addition, special trains transported about 55,000 maunds of weeviled gram and gram *chuni* to meet the requirements of concentrates. During this period 2,300 tons of *jowar* seeds were also moved to Saurashtra in order to be utilized for sowing fodder crops during the current season. Within a short period the entire stocks from Madhyabharat and Jhansi Division had been cleared. The transport of stocks from other areas was also on schedule and two more steamers with about 30,000 bales had left Bombay for Bhavnagar. Some congestion was also reported at Navlakhi, but with the cooperation of the Saurashtra Government, the

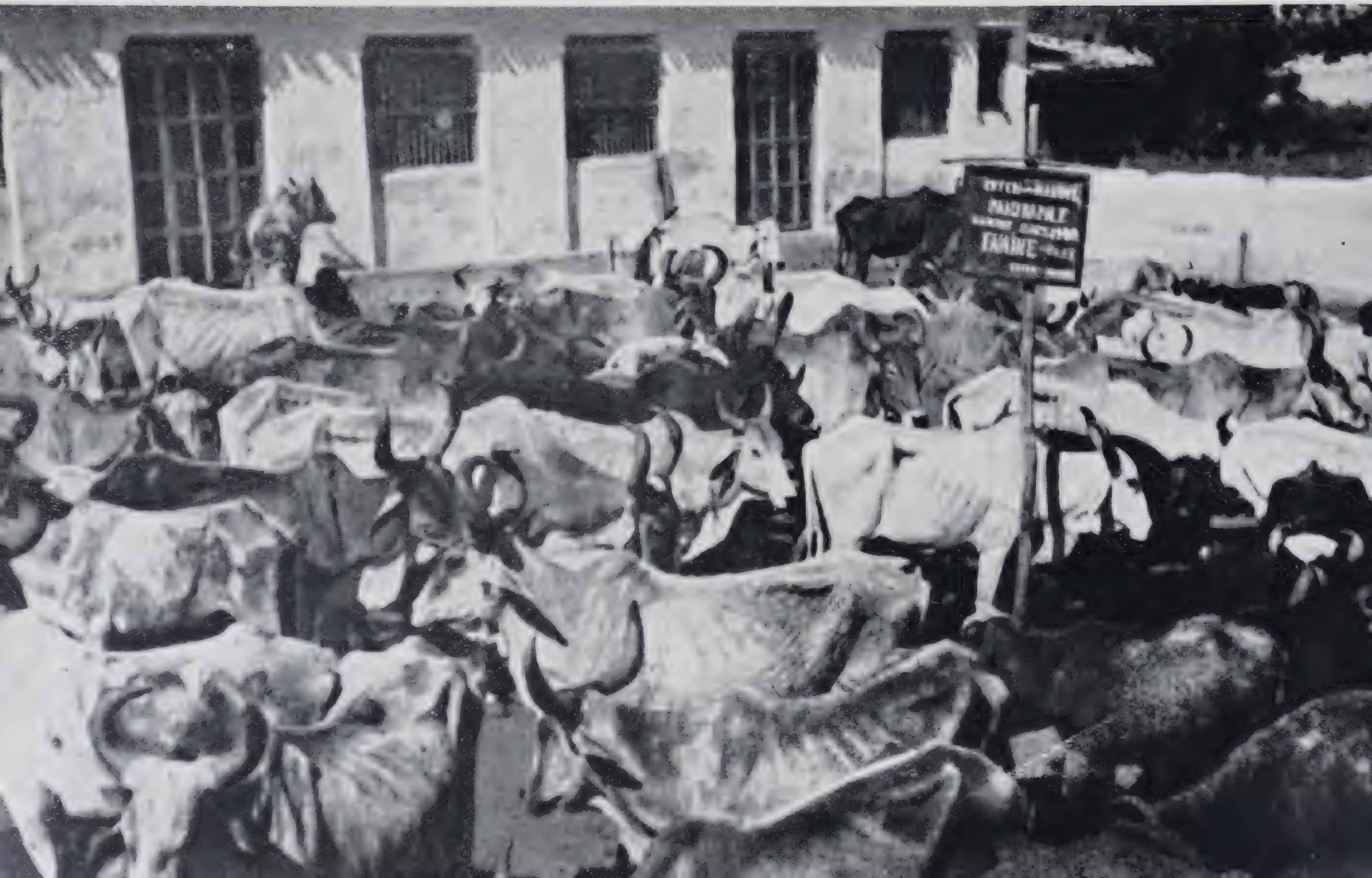

FIG. 1. Abandoned cattle collected in *pinjrapoles* for relief during the fodder famine

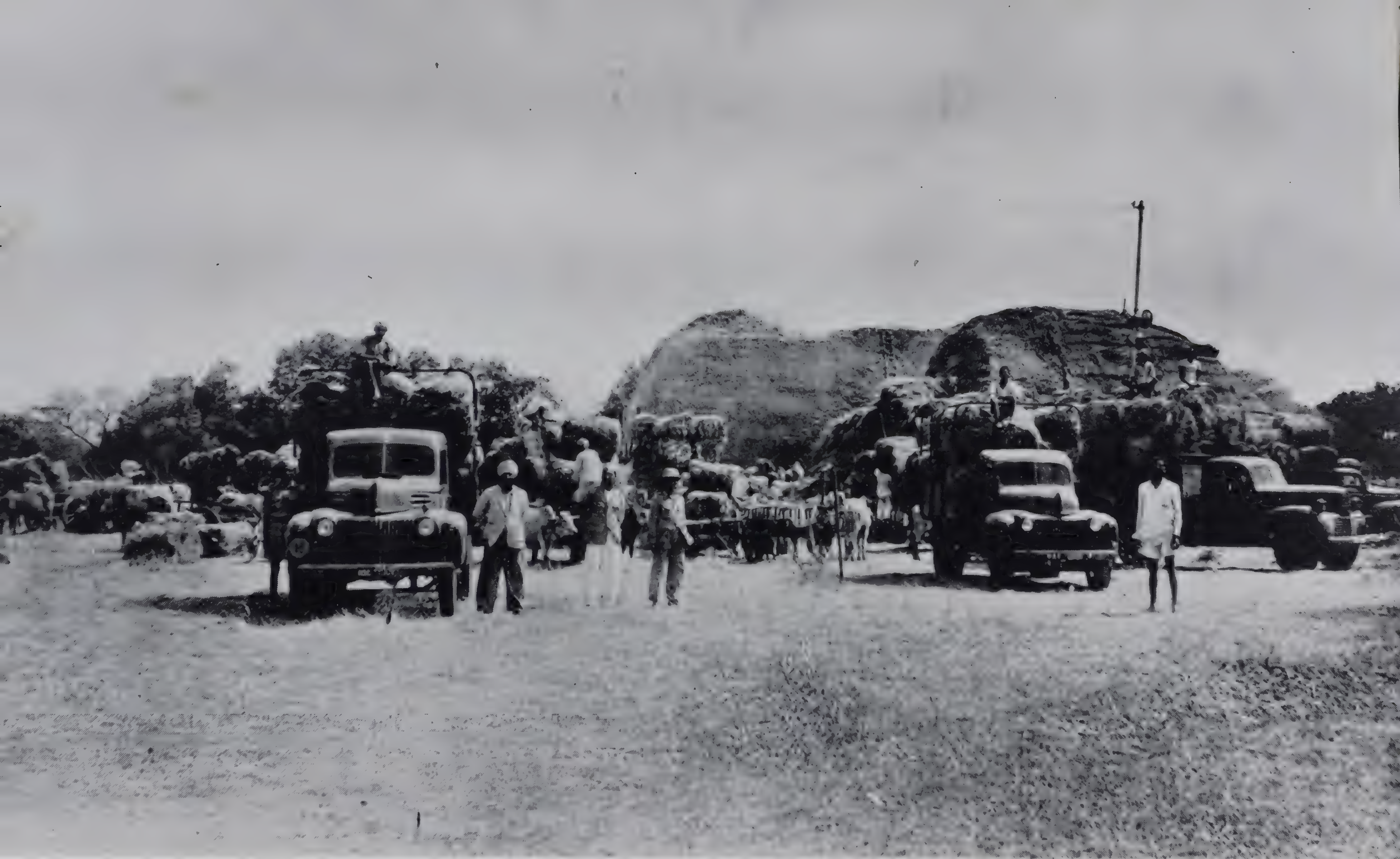

FIG. 2. Loading of bales of hay from Forest Department Grass Depot for transportation to the Railway Station, Indore

The bull is active and in service

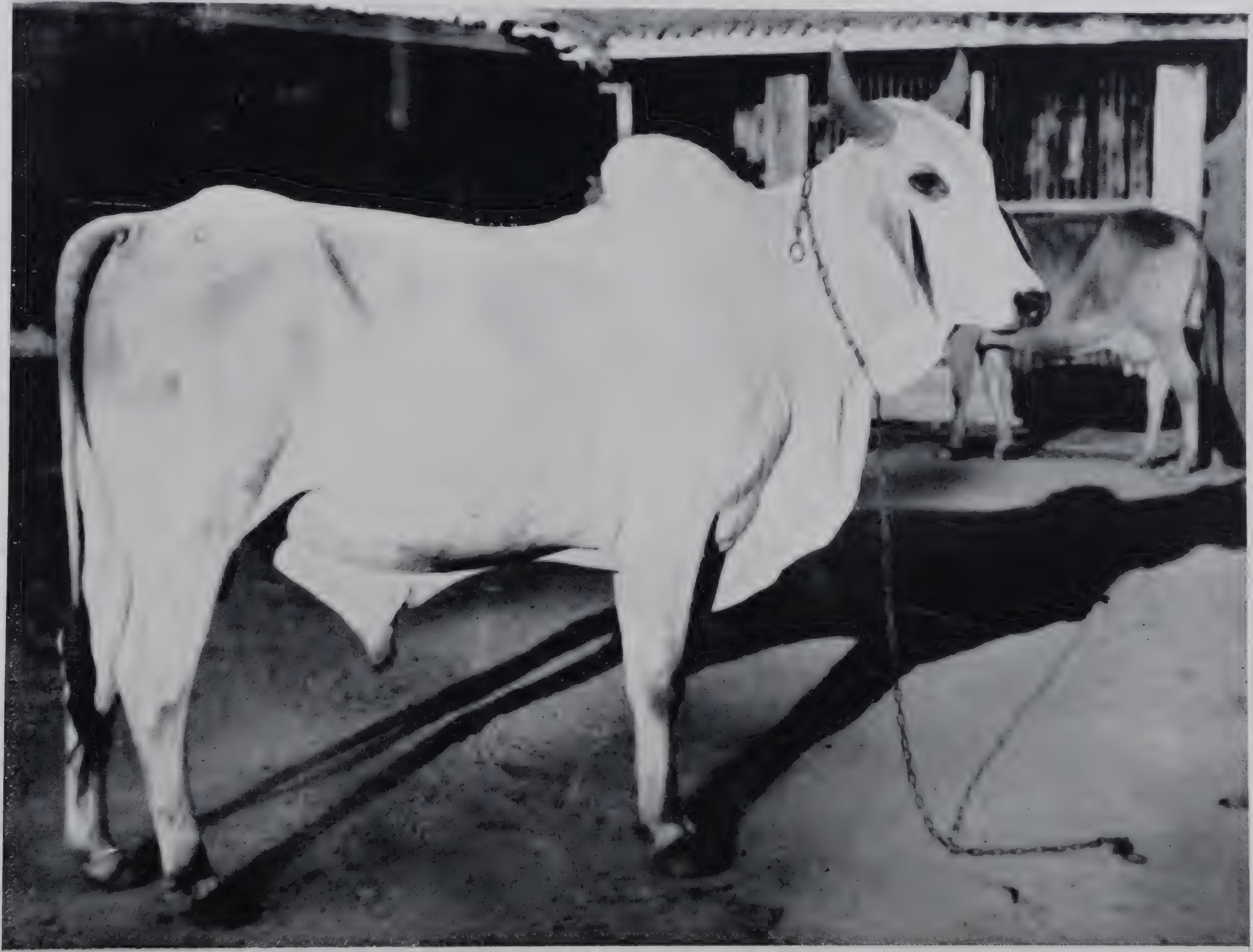

PLATE 66

services of two tugs, 15 barges and two propellers were secured and the accumulated stock was cleared within a few days.

The 'out of danger' signal has now been hoisted in the two areas, as sufficient stocks have been moved to last until the onset of the rains. A noteworthy feature of the famine relief operations is not only the saving of cattle lives but also a considerable saving in expenditure. Against a total estimated expenditure of Rs. 108 lakhs sanctioned by the Government for fighting the famine in Cutch, the operations were completed at a remarkably low cost of approximately Rs. 30 lakhs which has been possible only because of the well-planned and coordinated efforts of officials and non-officials, who fought back a famine of unprecedented proportions. (*P.I.B.*).

IMPROVEMENT IN COTTON MARKETING

THE Cotton Marketing Committee appointed by the Ministry of Agriculture to suggest ways and means of improving the marketing of cotton has addressed Provincial and State Governments and some organizations dealing with cotton for their views on the improvement of cotton marketing in the country. Institutions and individuals interested in the subject who wish to offer their views, are advised to send their opinions to the Secretary, Cotton Marketing Committee, Directorate of Marketing and Inspection, 'P' Block, New Delhi, so as to reach him by September 15, 1949. (*P.I.B.*)

* * *

THE 11th ALL-INDIA BEE-KEEPERS' CONFERENCE AND BEE EXHIBITION

The 11th All-India Bee-Keepers' Conference and Bee Exhibition will be held on the 2nd, 3rd and 4th December, 1949. Arrangements are being made to hold Agri—Horti—Industrial exhibition along with the same. Persons requiring any information are requested to write to the Secretary, Reception Committee, 11th All-India Bee-Keepers' Conference and Bee Exhibition, Gandhigram, Nandgad District, Belgaum.

PAPAIN

By M. B. R. SINGH

A PRODUCT which has a great future before it is papain, contained in the latex of the milky juice of the papaw (*Carica papaya*) tree. Papain is an active enzyme akin to pepsin. Its uses are mainly medicinal though it is put to several industrial uses as well. In medicine papain is used for combating dyspepsia and other digestive disorders. It is also employed in cures for diphtheria, cancer, and as a vermifuge. It was used as a valuable cholera bacteriophage during the cholera epidemic in South India in 1943-44. In France it is mixed with starch to preserve it and is often made up in the form of papain lozenges 'Syrup de Papain'. Papain wine and papain elixir are also favourite forms. It is used in the treatment of bleeding piles, ulcers, ringworm, enlargement of the spleen and tapeworm. It is also used in criminal abortion. The bruised leaves applied as a poultice have an excellent influence in reducing elephantoid growth. It is used in the preparation of chewing gum in the U.S.A. and in preparations for tenderizing meat. A solution of papain can be used as a substitute for curdling milk. Due to its capacity for digesting protein it is used in the brewing industry in a process for making 'chill-proof' beer. It has also been found useful in tanning leather. Recently papain has been used for degumming natural silk when it is mixed with rayon or wool in fabric weaving. It has also found application in the woollen industry. Wool treated with papain is found to take on a silk-like sheen and its tendency to tickle the skin and shrinkage is eliminated. It is stated that this anti-shrinkage treatment gives the woollen garment a greater range of usefulness than hitherto and permits their being washed in the same way as cotton garments. In Australia it was claimed that nearly 5,00,000 pairs of socks could be treated every week by the above process at the cost of one penny per pair. Papaw juice is also used for softening *tasar* cocoon and thus facilitating their being reeled. At present Ceylon and Tanganyika are the only countries producing papain on a commercial scale. Although possibilities of its production in India exist not much progress has so far been made. Before the war Japan exported some quantity mainly produced in one of the Caroline Islands in the Pacific. Till 1944 Ceylon was the chief exporting country but for the last few years the first place has been taken by Tanganyika. The increase in demand in papain is attributed to the world shortage of pepsin which is not likely to be overcome for some time. There are two grades of papain, viz. (1) sun dried and (2) oven dried. The latter is of a better colour, greater enzymatic activity and realizes better prices. Before the war the average price in London of Ceylon papain of good digestive value was only eight shillings per lb. The oven-dried papain usually commanding a premium of 3d. to 6d. per lb. over the sun dried. The chief importer of papain is the U.S.A. In 1938 the U.S.A. imported 2,23,000 lb. of crude papain valued at Rs.3,29,000 as against 1,80,000 lb. valued at Rs. 2,65,000 in 1937 and 54,000 lb. valued at Rs. 50,000 in 1932.

DIPLOMA IN FRUIT PRESERVATION AND CANNING

The following candidates have been declared successful in the Diploma Examination in Fruit Preservation and Canning held in August 1949, under the auspices of the Indian Council of Agricultural Research :

First Division

Miss P. Parvathi (Madras); Miss C. K. Rajam (Madras); Miss Nirmal Bhasin (Delhi) and Mrs. Kamini Kaul (Himachal Pradesh).

Second Division

Miss G. K. Guanambal (Madras); Miss Satwant Kaur (East Punjab) and Miss Swaran Pasticha (Delhi).

* * *

CERTIFICATE IN AGRICULTURAL STATISTICS

The following students have passd the examination of the post-graduate Certificate Course in Agricultural Statistics of the Indian Council of Agricultural Research, held in August, 1949 :

First Division

Mr. S. R. Sharma.

Second Division

Messrs. M. A. Telang, D. R. Kohli, P. N. Mathur, G. K. Mathur, A. S. V. Gopalan, B. D. Tikkiwal, S. S. Chinney and B. M. Kumbhare.—(*P.I.B.*)

ERRATA

Indian Farming, Vol. X, No. 6, June 1949, page 245, Table III :

Under D-4 (No. 1) Caterpillar Tractor, Period 2nd, last item (Depreciation), for 8701 *read* 870.

Under D-4 (No. 2) Caterpillar Tractor, Period 1st, last item (Depreciation), for 910 *read* 1910.

Under Farmall Row Crop Tractor, Period 1st, 5th item (Lubricating oils), for 30 *read* 130.

Under W.D. 40 McCormick Deering, Period 2nd, 6th item (Repair and servicing) for 178 *read* 187.

COVER ILLUSTRATION

H. E. Shri C. Rajagopalachari, Governor-General of India, along with others inspecting the maize harvest in the Estate.

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INDIAN FARMING

NOVEMBER, 1949

Vol. X No. 11

DEVELOPMENT OF BONE-MEAL INDUSTRY*

WE are meeting after more than one year. I think some of you were present at a Conference which was called some time about the middle of last year—I think in the month of May. But this time we have troubled you really for the consideration of more fundamental problems relating to the bone industry.

I feel that the time is opportune for placing our bone industry on a stable foundation if we plan properly at this time. As you know, our food production programme with its time-limit and other compelling circumstances will necessitate more and more attention being paid to the development of local resources for manures and fertilizers. Even independently of this immediate programme, the bigger schemes for both food production and agricultural development will necessitate larger and larger use of fertilizers and manures, and, obviously, bone in India is a big source for manufacturing our own fertilizers. In the course of discussion of the agenda I would wish you to have that larger objective before you, so that as a result of these discussions we might be able to reach decisions which would have considerable effect on the industry.

While discussing the items on the agenda and pressing the individual points of view of each interest, I would request you to try to reconcile the conflicting opinions, attitudes and lines of action of the different interests. Unless such reconcilation is arrived at, we will not be able to make due progress. It is only when each interest tries also to look at a problem from the point of view of the opposite interest that the ultimate decision goes through with maximum cooperation. I would, therefore, wish you to have that attitude in dealing with the problem before you.

Now, one of the items which has to be considered by you is how to increase the raw materials of the industry, that is, what steps should be taken to see that we get the largest quantity of raw bone. Then the other matter that you have to see to is, having secured the largest quantity of raw materials, how we can utilize it. At present there are certain factors which compel the industry to export crushed bones, leaving here in the country bone-meal for use by the agriculturists. But this, as you will all agree, is a temporary phase. In most countries of the world, the bone industry has reached a stage when the entire raw material is utilized by producing other articles from it. I would, therefore, request those who take part in the discussion today to throw some light on that aspect of the question—that is, what exactly is the stage that the industry in India has reached for utilizing the entire raw material.

I propose at this Conference to follow the procedure of having a general discussion for some time and then set up committees to deal with some of the items. Then the reports of those committees may be considered on Wednesday, if you will be here till then. Otherwise, we will have to have a late evening sitting to consider the reports of these committees. I want the full utilization of the raw materials to be considered by a committee on which the various interests may be represented.

Then there is this question of the by-product bone-meal which we want for agricultural operations. Possibly most of you feel that this is probably the most important item to be dealt with—that is, the fixation of the price of bone-meal. There are various standpoints from which a decision with regard to the price of bone-meal could be considered. But I would like you, if you have the active interest, the larger and abiding interest of the industry at heart, to take one fact into consideration. After all, whatever might be the price which you may work out for the bone-meal on the basis of the price of crushed bone, as well as the cost of manufacture, the bone-meal is required by the agriculturists and if the agriculturist finds that the price which he has to pay for the bone-meal is not low enough for him and it has no relationship to the value of the extra produce which he receives as a result of the use of bone-meal, he is not likely to take to it. So far as Government is concerned, we want to utilize our fertilizer and manure resources to the maximum extent possible for our urgent needs and one of the most urgent needs is food production. We have also got programmes for the development of the cultivation of jute and cotton. But relatively food production is the most important of our programmes. Therefore, in fixing the price of bone-meal, the over-riding consideration that ultimately will sustain the industry, or ultimately make it possible for the agriculturists to continue to be the purchasers, consumers and customers of this product is that its price must be related to the return which the agriculturist gets. Last time we had fixed the price of bone-meal at Rs. 170 per ton. So far as I can recall, no very detailed examination of any data or material was made by us in fixing this price. We were given certain figures with regard to the price of crushed bone, as well as the cost of production, on the basis of which we fixed the price. Now we have to deal with this matter in a more detailed manner. If we want to make bone-meal a popular fertilizer, then, as I said, you must see that the price has a bearing on the return of the agriculturists. If all the data is available with you here, then it may be possible, sitting for a number of hours, to go through them. Otherwise, we will have to collect the information from sample factories, with the cooperation of the manufacturers. I find, from the views expressed by some of your representatives, that it is your desire to fix a figure as high as Rs. 200 to Rs. 220. But, as I said, this is a matter which has to be examined in some detail.

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* Inaugural address delivered by the Hon'ble Shri Jairamdas Daulatram on 23 August, 1949, at a Conference in New Delhi convened by the Central Ministry of Agriculture for the development of bone-meal industry.

It is a fact that the raw material of the bone industry is mostly available far into the interior of the country, I mean the rural areas, while factories are concentrated in a few urban areas. The same is the case with regard to certain other industries as well. Take for instance the sugar industry. Most of the sugar factories have got concentrated in two provinces whereas the consumers are scattered all over the country. It has been suggested with regard to the bone industry that since the raw material is scattered throughout the country and the consumers are also scattered throughout the country, decentralization of the industry will lead to greater efficiency. These decentralized factories may be individual factories or cooperative factories. All these are matters of detail which have to be worked out.

At present we find that we are very much in the dark with regard to our statistical position. We do not know what is the total quantity of raw bones of various kinds available in the country. Nor do we know how much ultimately goes waste or is absorbed by the soil. We also do not know as to what is the exact quantity which can be utilized by the industry. A great deal of other detail is necessary and I hope your organization will assist us in getting correct statistics.

We shall also be glad to hear from you what assistance you require from Government in the matter of expanding the bone industry.

The present practice is to export our crushed bones and to import rock phosphates. I do not know how far it is possible always to correlate the two things. But I feel that whatever may be the programme at present of importing rock phosphates it may be wiser ultimately that our fertilizer industry must be based on internal raw materials. We know our industrial development is often based on raw material which has got to be imported. But then many difficulties can arise which may prevent us from getting our raw materials. Wars occur and other complications can also come about. Though the bone industry is developing on the basis of rock phosphates, I think it is wise to plan for the development of the industry on internal resources. This should be considered and investigated though I realize no decision can be taken at this Conference.

TREAT YOUR CEREAL SEEDS AND CONTROL MANY SERIOUS DISEASES

By H. S. PRUTHI

WHEN a farmer plants his seed of cereal and other crops, the stands of seedlings and later health of adult plants that he obtains may not as a rule be good. If the crop is to be transplanted, the seed rate in such cases has to be high because there is a great deal of pre-emergence rot of the seed and of seedlings due to 'damping off' or 'seedling blight'. That is because the seed of some of the cereal crops carry with them spores of parasitic fungi or such spores may lie in the soil and attack the kernels and the young seedlings as they emerge out of the seed and come out of the soil. If the conditions of environment are favourable for disease development then such mortality is very high. As a general rule, however, even when the conditions are not optimum, some seed and seedlings succumb to the injuries which these fungi and sometimes even parasitic bacteria cause to them. Losses due to such 'pre-emergence rot', 'damping off', 'seedling blight', 'foot-rot', etc. are sometimes very appreciable necessitating replanting or excessive seed rate. Foot-rot for example may cause considerable damage to the wheat crop in many parts of India, especially Central Provinces and Rajputana. The seed rate has therefore to be high as much as 130 lb. per acre instead of a normal rate of 60 to 70 lb. Foot-rot of rice occurs in Madras, Bengal, Assam and other places and effects the crop in all stages of growth but is mostly destructive in the seedling stage. Another important disease of rice is seedling blight which commonly occurs in Bengal, Orissa and Madras. Seedling blight causes considerable losses in India. Certain smut diseases such as grain and loose smuts of *jowar*, covered smut of barley, flag smut of wheat, covered and loose smuts of oats cause considerable damage to the yield and quality of the grains. Leaf spot of wheat which normally occurs in the Punjab is also now reported to occur extensively in certain wheat growing areas of the south. Damage due to the disease has been appreciable in certain years and in South India it has been recently observed in a serious form. Stripe disease of barley is also a common disease which may cause either pre-emergence rot or seedling blight. Under favourable weather conditions, the course of the disease is usually progressive until finally the ears are infected when they fail to develop normally and a condition of partial or complete blindness results.

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Seed treatment

It is the object of this article to explain that the diseases described above which are externally seed borne or sometimes also soil-borne, can be successfully controlled by seed treatment. Diseases caused by air-borne spores such as rusts, mildews, head blights or the internally seed borne diseases such as loose smut of wheat and barley cannot be controlled by seed treatment.

Treating the seeds with dusts which have fungicidal and bactericidal qualities provides an effective barrier against the growth and entry of the organisms into the seed. Some fungicides give additional protection by diffusing into the soil around the seed and retarding the growth of parasitic fungi that may be present in the soil.

The ultimate aim of seed dressing, therefore, is to secure good stands of healthy plants and therefore good yields from the crop. The fact that good stands and yields are often obtained without seed treatment should not lessen its importance because seed treatment is a prophylactic measure which is practised irrespective of whether the disease in a season is or is not present. If the seed has not been treated and the disease appears in an epidemic form, it would be too late to put into effect this practical method for preventing such diseases. Seed treatment, therefore, is an insurance against loss of crops.

Dressing the seed with fungicidal dusts will, therefore, prove to be beneficial in several ways.

1. Fungicidal seed dressings destroy the externally seed-borne fungi causing plant diseases, thus increasing yields and quality of the crop.
2. They combat harmful soil inhabiting fungi that rot the seed and destroy the seedlings.
3. They help in establishing good vigorous stands which enable the crop to compete successfully with weeds.

The fact that seed looks clean or that it was the produce of an apparently disease-free crop grown from treated seed is no guarantee that it is disease-free and therefore not in need of treatment. Spores of several parasitic fungi carried beneath the hulls of oats, barley and rice and in the crease of wheat kernels are not easily observable. Even seed from a disease-free field may become contaminated by spores carried out by the wind or by the threshing machines from neighbouring fields. It is a good practice, therefore, to treat seed every year to ensure freedom from disease.

Different kinds of seed treatment

There are two ways in which seed can be treated, namely, wet treatment using dilute solutions of the fungicides or the dry treatment. For the wet treatments the fungicides must, of course, be soluble in water and those that are usually used are copper sulphate, formalin or some kind of water soluble organic mercury compounds. For dry treatment, the fungicides used are basic copper carbonate, different kinds of copper oxides and organic mercury or sulphur compounds which are sold in a ready made form properly diluted by commercial concerns. Recently, some organic mercury compounds have been suspended or dissolved in liquids of the consistency of the pure glycerine or heavy syrup which are used directly for treating the seed, like the dusts themselves.

Wet treatments: (a) Copper sulphate (2½ lb. of copper sulphate dissolved in 10 gallons of water) is a good fungicide for the control of smuts of *jowar* but it has the drawback of impairing germination of seed which in some circumstances may be appreciable; moreover, if not carefully carried out abnormal seedlings may be produced. It is not a suitable fungicide for oats, barley or rice as the vitality of these grains is injured by such treatment.

(b) Formalin: (1 pint of formalin in 40 gallons of water) is comparatively a more suitable fungicide and gives excellent control of not only oat smuts but covered smut of barley and loose and covered smuts of *jowar* as well; but in the case of the latter crop as the seeds are not covered by hulls the germination may get somewhat impaired. Moreover, it does not give a satisfactory control of diseases of wheat, barley, rice and oats due to Helminthosporium.

Dry treatments: The wet treatments have several disadvantages, the chief among which is the moisture of the treated seed which, if not quickly dried, may impair its germination. Moreover, seed treated by the wet methods cannot be stored for long periods but have to be used immediately and such treatments do not act as protectives. To overcome these drawbacks, dry fungicidal dusts have been developed which give excellent results. It may be stated that the success of dry dusts is intimately related to the fineness of the dust. If the dust is not extremely fine, that is of the order of passing through a sieve with 300 meshes per linear inch, its effectiveness may not be very satisfactory.

(a) Copper carbonate and oxide dusts: One of the materials, first used as a dust, was a finely divided basic copper carbonate powder. This dust (three to four ounces per maund* of seed) gives a fair control of *jowar* smuts provided that the grain is not badly contaminated. Other dusts are Yellow Cuprocide, red oxide of copper, etc. which are also used in more or less the same proportion. However, these dusts besides controlling smuts, do not control other seed-borne diseases as satisfactorily.

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* One maund = 82⅛ lb.

(b) Sulphur dust: Sulphur dust of extreme fineness, that is capable of passing through a sieve which is 300 meshes per linear inch, is very popular in India on account of ease of application, safety and cheapness of sulphur. It has been successfully used against grain and loose smuts of *jowar* and covered smut of barley. Three or four ounces of the dust to a maund of the seed grain are quite satisfactory.

(c) Organic mercury compounds: These materials have been found to be very useful, for they give good control not only of smuts but of numerous other diseases and prevent especially the pre-emergence rot of several crops. The proprietary organic mercurial seed-disinfectants vary in composition according to the particular commercial product. Their main ingredients are usually the effective organic mercury compound which may be ethyl mercury phosphate, ethyl mercury chloride, ethyl mercury acetate or other similar compounds. Usually the effective ingredient is one to three per cent, the rest being an inert diluent which serves as a carrier. Chief among such dusts are Agrosan GN, Semesan and New Improved Ceresan.

Non-metallic organic compounds: Several organic compounds without mercury in them have recently come into use as seed disinfectants. They are Spergon (Tetra-chloro-p-benzoquinone), Thiosan and Arasan (Tetramethylthiuram-disulphide). They also give effective control of seed-borne diseases and for certain vegetable crop seeds Spergon has been declared to be very effective even though a bit more expensive than the other dusts.

It may be mentioned that organic mercury dusts are probably the best all-round seed fungicides. They are not only effective in controlling certain diseases but they also provide protection to the seed and thus improve germination and crop stands.

New liquid treatments: Among the new liquid treatments which are used in the same manner as dust is Panogen which is a Swedish product. It contains an alkyl mercury compound as its active ingredient and controls all parasitic fungi. Panogen is applied to the seed in the same manner as an ordinary dry seed dressing. The dose is 100 c.c. for 110 pounds of seed or roughly 1 c.c. for one pound of seed.

How to treat seed

Small quantities of seed may be treated by placing the required quantity of the dust in a bottle and shaking vigorously for two or three minutes.

An earthen pot with a lid may be used when a few seers of seed have to be treated. The grain and the required quantity of dust are placed inside the pot which is well-shaken for a couple of minutes after covering the mouth with the lid. Care must be taken to see that the pot is not more than half full.

For larger quantities a seed treating drum is very convenient and useful. Such a machine may either be got made locally or purchased ready-made through a manufacturer. It consists of an ordinary oil drum to which is welded an iron pipe. The pipe rests on the two sides on wooden or iron pivots so that the drum can rotate (Fig. 1). The method of treatment is a simple one. The grain is placed in the drum, the required dose of the fungicide added and the drum is revolved for three to four minutes. In this way each grain is coated with a very fine deposit of the fungicide.

Dosage: The quantity of the fungicide to be used varies somewhat with the crop, the disease and the fungicide used. The usual dose is 1 part of the disinfectant to 450 or 500 parts of seed. This comes to 5 to 7 tolas of the dust to 1 maund of seed.

Precautions: Certain elementary precautions must be taken when using the poisonous materials. It is advisable to avoid inhaling the dust. The nose and the mouth should therefore be protected with a cloth or a respirator. The fungicide should not be handled with wet or moist hands, and should not be allowed to come into contact with wounds or broken skin. After the treatment is over, any dressing on the hands should be removed by rinsing thoroughly.

The bags which have contained treated seed should be kept separately and washed before using them for carrying fodder, etc.

It is advisable that the mixing of the dust with the grain should be done in a reliable dust-proof machine. Grain should not be mixed with the powder on the barn floor or the mixing carried out in a sack.

Seed can be treated three to four months before sowing without impairing its germination. But the treated seed should be stored in a dry and ventilated place.

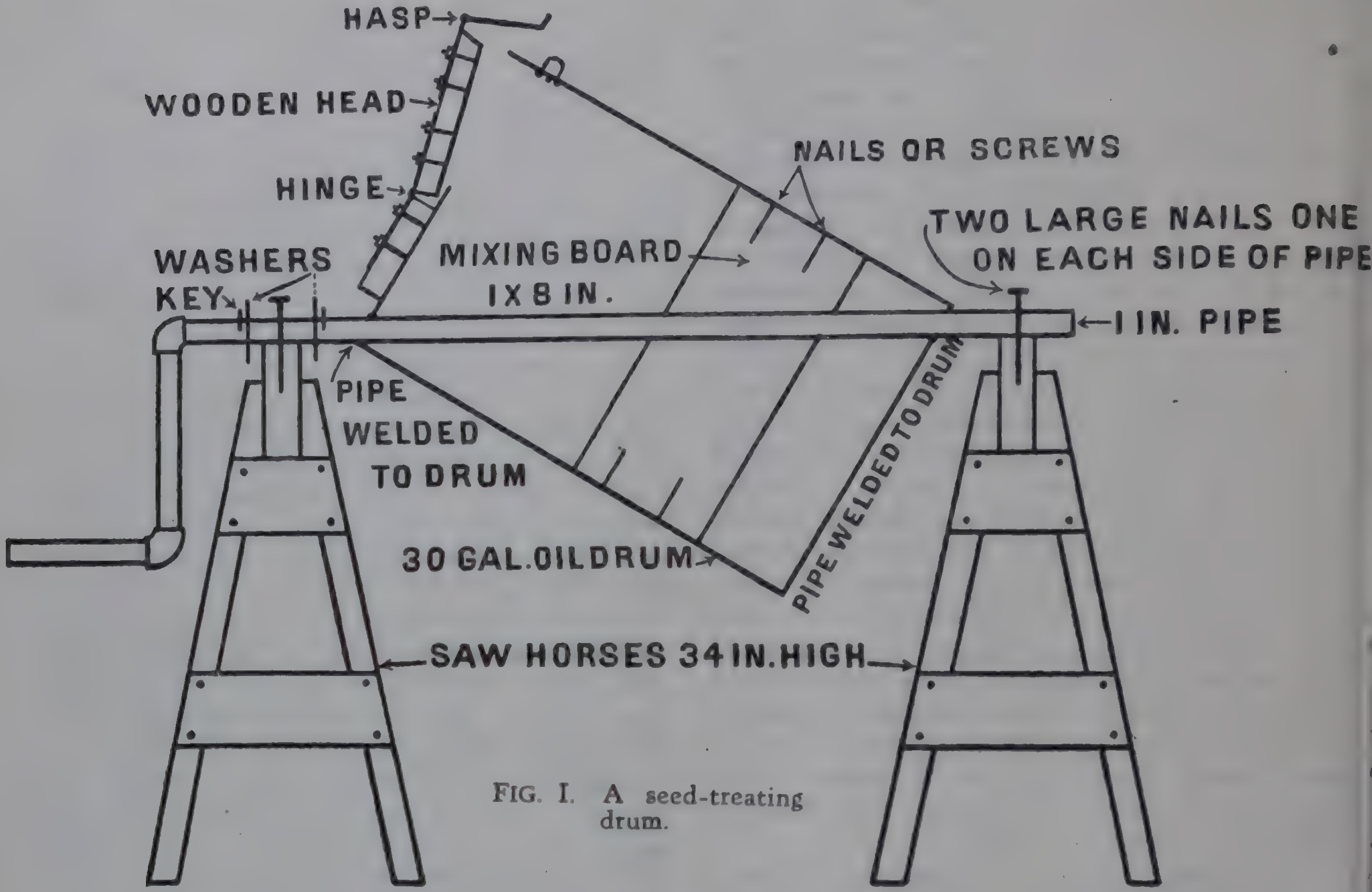
HASP
WOODEN HEAD
HINGE
WASHERS
KEY
MIXING BOARD 1X8 IN.
NAILS OR SCREWS
TWO LARGE NAILS ONE ON EACH SIDE OF PIPE
1 IN. PIPE
PIPE WELDED TO DRUM
PIPE WELDED TO DRUM
30 GAL. OIL DRUM
SAW HORSES 34 IN. HIGH

FIG. I. A seed-treating drum.

Cost of treatment

The cost of seed treatment varies with the cost of the material, the rate of application per maund and the seed rate per acre. On an average, the cost of treatment comes to about two to three annas per acre, being little more for wheat, barley and oats and much less for *jowar*, maize and rice. The cost of treatment of *jowar* seed comes to as low as one pice per acre. There is no doubt that the treatment will yield dividends several times over.

Hints for seed dressing

(i) Seed must be thoroughly dry at the time of treatment.

(ii) Do not fill more than half the seed-treating drum at a time.

(iii) Add the fungicide @ 1 in 450 to 500 parts, say five to seven tolas to a maund of seed.

(iv) Slowly rotate the drum for about 3 to 5 minutes (at least 100 rotations).

(v) Empty out the drum in such a way that the dust blows away from the operator.

(vi) Carefully label the treated seed.

(vii) The treated seed should be stored in a dry, well-ventilated place. If need be, the seed may be sown immediately after treatment. *In any case, do not store the treated seed in a closed room.*

(viii) The treated seed should never be used as food for human beings or as feed for livestock. It should only be used as seed.

(ix) When the treating operations are over, the drum should be thoroughly washed with water so as to remove the sticking dust particles and later dried.

ROLE OF *GAUSHALAS* AND *PINJRAPOLES* IN THE CATTLE ECONOMY OF INDIA

By HARBANS SINGH

GAUSHALA literally means the home for cows. *Pinjrapole*, which means home for disabled animals, may also look after other kinds of animals besides the bovine.

These institutions are India's great heritage. During the last two centuries or so, due to economic and other factors, the slaughter of cows which was originally unknown to the people of India became a common practice. The trade in dead animals and their products became more flourishing than that of living animals and their products. The cow which was once considered the index of economic prosperity of the nation did not remain as such. In order, therefore, to arrest any further deterioration of the cow as a giver of milk and draught power and to give her necessary protection from indiscriminate slaughter and to house those infirm animals which have served throughout their lives, during their old age, the present day institutions of *gaushalas* and *pinjrapoles* were founded.

Number of gaushalas *and their distribution*

It is estimated that there are at present about three thousand *gaushalas* and *pinjrapoles* in India with a population of six lakh heads of cattle which are being maintained at a cost of about sixty million rupees per annum.

The following Table will show the estimated number of major *gaushalas* in various provinces and States:

TABLE I

Estimated number of major gaushalas *in provinces and States.*

S. No.	Province /State	Number of major *gaushalas*
1.	Ajmer-Merwara ...	7
2.	Assam	7
3.	Bhopal	10
4.	Bihar	100
5.	Bombay	90
6.	Central Provinces and Berar	60
7.	Cutch	23
8.	Delhi	7
9.	East Punjab	80
10.	Madras	50
11.	Orissa	20
12.	United Provinces ...	180
13.	West Bengal	25
14.	Hyderabad State... ...	15
15.	Kashmir and Jammu State ...	10
16.	Madhya Bharat Union ...	75
17.	Mysore State	20
18.	Patiala and East Punjab States Union	40
19.	Saurashtra Union ...	100
20.	United States of Vindya Pradesh	50
21.	United States of Rajasthan ...	200
22.	Other areas ...	200

Potentialities

It is estimated that on an average twenty per cent of cattle maintained in these institutions could be classified as good dairy type. There are another twenty per cent which are fit for breeding and further grading while the remaining sixty per cent are old, infirm and unfit for further breeding. Thus, taking total population of these institutions at six lakhs, the number of cattle under different classes would work out as below:

S. No.	Class	Number	Percentage
1.	Good dairy type ...	1,20,000	20
2.	Fit for breeding ...	1,20,000	20
3.	Old, infirm and unfit for breeding ...	3,60,000	60
	Total ...	6,00,000	100

It was considered that by better management of animals in the first two categories

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it was possible not only to substantially effect increase in the present output of milk from these institutions but also to convert them into centres for the breeding of improved bulls and bullocks. It was estimated that by proper handling an increased quantity of over one million maunds of milk per year could be produced from these institutions. At the same time they could provide twenty-five thousand males fit for use as stud bulls every year for replacement in the *gaushalas* and for distribution in the neighbouring areas for the improvement of ordinary village cattle. In addition to this, there will be about the same number of males available, after castration, for bullock work and fifty thousand improved female calves every year. These institutions could also serve the purpose of providing suitable centres for salvage of dry cattle from cities and towns. At present, due to lack of such facilities a large number of really fit milch animals which go to the big cities, find their way to the slaughter-houses after they go dry. Thus it will be seen that *gaushalas* and *pinjrapoles* do not only possess great potentialities as means of improvement of milk supply to the towns but can also serve effectively as centres for the preservation and betterment of the cattle wealth of the country.

Present conditions

Preliminary survey of these institutions has revealed the following main facts:

(1) *Gaushalas* and *pinjrapoles* are generally situated either in the heart of big towns or in their immediate neighbourhood ; where feeding and maintenance of cattle are unnecessarily costly.

(2) In most of these institutions the tendency is to overstock, with the result that the animals are generally underfed and are not properly looked after. This entails great hardship and suffering for the animals.

(3) There are no means of segregating the productive animals from those which are aged, infirm or otherwise economically useless. Thus, no discrimination is practicable in the feeding and management of good animals from that of unproductive ones, which makes good animals also worthless after a short time.

(4) Land attached to the *gaushalas* is generally insufficient for grazing of cattle or raising of fodder crops.

(5) Promiscuous breeding is practised as a general rule and no attention is paid to the selection of bulls for breeding which results in further increase in the number of inferior cattle.

(6) There are no proper facilities for veterinary aid or treatment of sick animals.

(7) Excepting a few *gaushalas*, which have their permanent funds managed by duly constituted trusts, the source of income of most of these institutions is from *Dharmada*, *Laga* or *Gaushala* Cess levied on the sale and purchase of principal commodities in different markets. There are some *gaushalas* which do not have the patronage of any business community and thus have to depend entirely on public charities and donations. Thus it will be seen that the income of these institutions is not only spasmodic and irregular but is also very uncertain which is a great handicap in envisaging permanent improvement in their management.

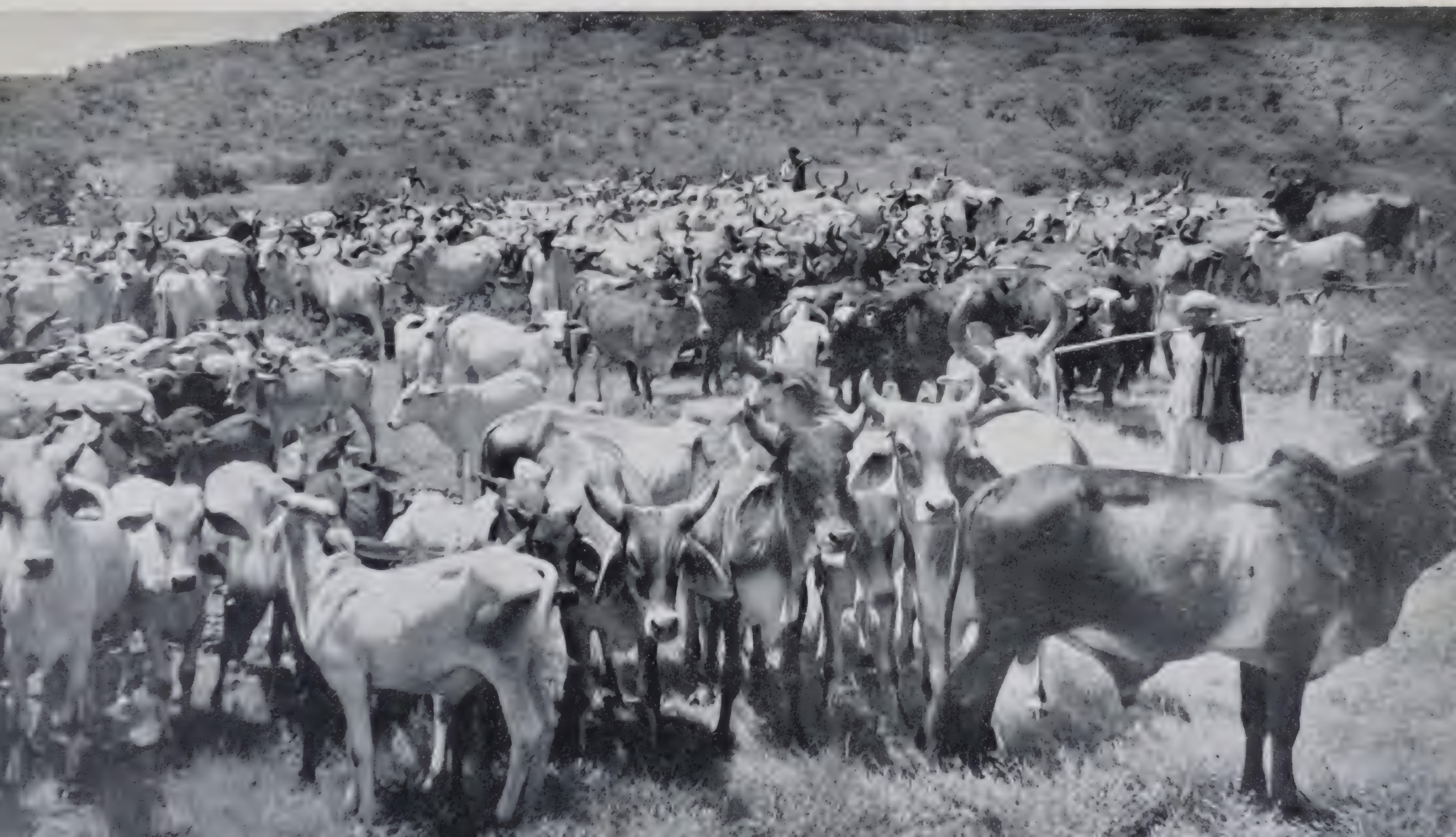
(8) These institutions are generally managed by untrained staff, and, therefore, there is no planned policy according to which the breeding and feeding of different types of animals and their management could be carried out.

Plan for their reorganization

It is, of course, not possible to suggest a common plan for the improvement of these institutions, situated under such widely different conditions. However, a general scheme for their reorganization is given below which may need slight modifications to suit local conditions. The plan essentially consists of the following four steps:

(1) *Segregation of different types of cattle*: In order to achieve results most economically and in the shortest possible time, the first step is to segregate the old, infirm and unproductive animals from the productive ones fit for breeding. Most of the *gaushalas* being located in or near towns, there is dearth of space leading to overcrowding and congestion. Moreover, high cost of feeding and labour in the cities makes the maintenance of productive type unnecessarily costly. It is, therefore, desirable that arrangements should be made to maintain these animals on grazings in the interior forests and other waste lands, without much cost, where they might even prove useful in fertilizing and developing the land. The funds and space thus saved by the removal

FIG. 1. Cattle on the Grazing Camp, Mandvi *Pinjrapole*, Kutch



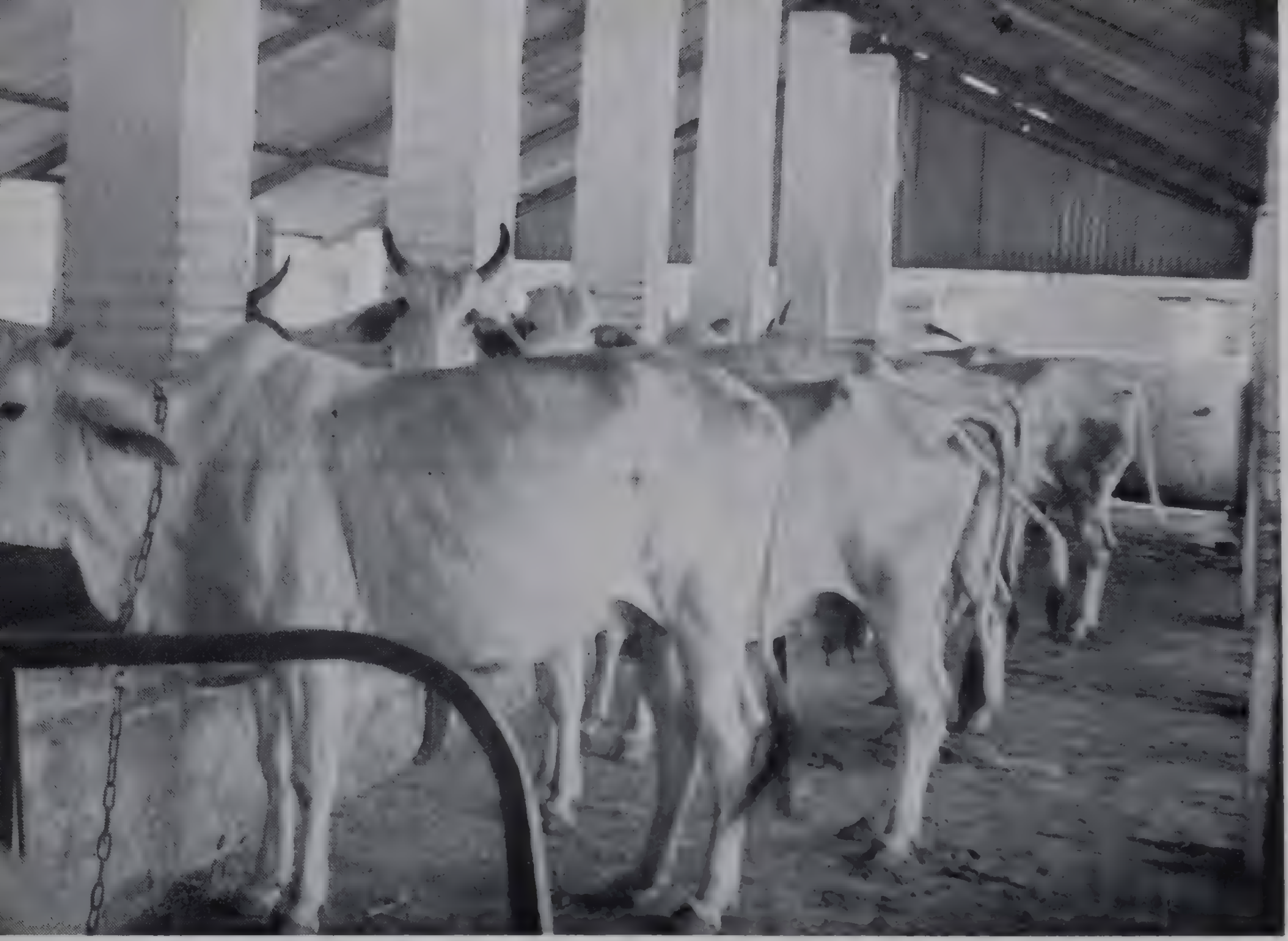


FIG. 2. Milking herd. Kanpur *Gaushala*

FIG. 3. Cattle Segregation Camp, Pashulok—Rishikesh

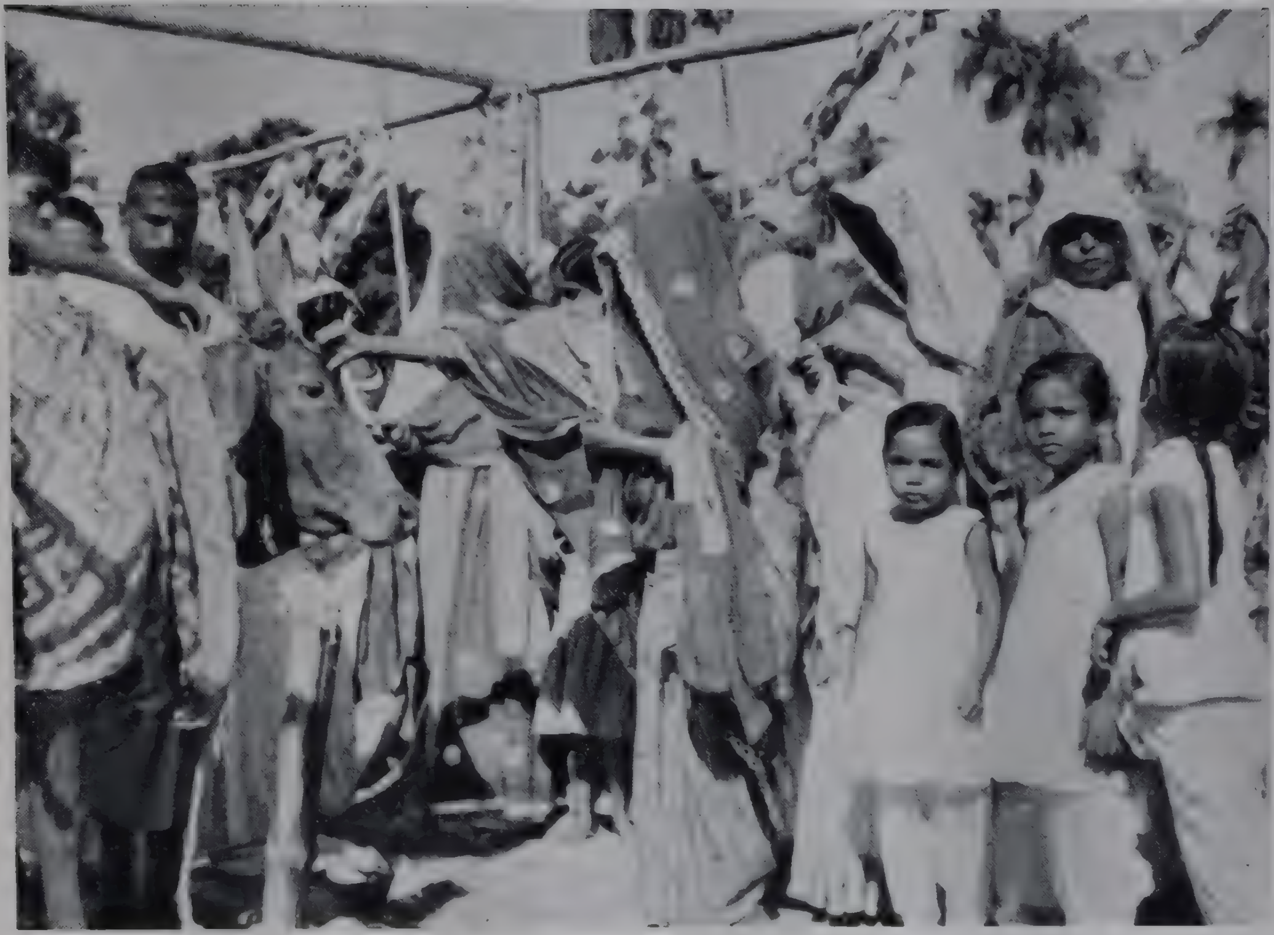


FIG. 4. Gopa-asthami Day. Gopal *Gaushala*, Dibrugarh, Assam

of useless stock can be more economically utilized for the upkeep of productive animals. Such cattle segregation camps or *Go Sadans* can be located in different zones in each province wherever suitable facilities are available. Provision should be made to castrate all males in these *Sadans* so that no further propagation takes place among these animals. The skin, bones and other offals of animals which die their natural death should be properly utilized.

For the upgrading of the productive stock, improved bulls of desirable breeds should be maintained in the *gaushalas*. Better feeding and management will go a long way in improving the yield of the milking herds.

(2) *Training of* gaushala *workers:* For efficient management of *gaushalas*, it is absolutely necessary that the persons in charge of these institutions should be trained and qualified in the handling and management of cattle. Due to dearth of technical and trained personnel it has been found difficult by the managements to effect improvements in their institutions. Efforts should be made by the *gaushalas* to get workers trained in suitable centres which are being started by the Provincial Governments in some of the provinces.

(3) *Provincial* Gaushala *Federation:* In order to develop these institutions on a, more or less, uniform standard of working, Provincial Federations of *Gaushalas* should be formed in each province and State Union. In an activity like this, where development of a large number of public institutions is concerned, formation of such non-official organizations is not only desirable but essential. These Provincial Federations may eventually have a Central All-India Federation to further coordinate their activities. Table II will give the names and addresses of the Federations already working in various provinces and States:

TABLE II

Gaushalas *working in different provinces and States*

Name of the province or State	Address	Date of formation
Ajmer-Merwara	The Federation of *Gaushala* and *Pinjrapoles*, Ajmer-Merwara, Ajmer	November, 1945
Assam	Assam Prantiya *Gaushala Sang*, Gauhati	April, 1949
Bihar	Bihar Provincial Federation of *Gaushalas* and *Pinjrapoles*, Sadaquat Ashram, P.O. Dighaghat, Patna	December, 1945
Bombay	Bombay Provincial Federation of *Gaushalas* and *Pinjrapoles*, C/o Bombay Humanitarian League, 149, Shroff Bazar, Bombay 2.	August, 1945
Central Provinces	Provincial *Gaushalas* and *Pinjrapoles* Federation, C/o Gau Sewa Sangh, Gopuri, Wardha	November, 1946
Cutch	Cutch Federation of *Pinjrapoles*, Anjar, Cutch	January, 1949
East Punjab and Delhi	East Punjab and Delhi Gau Sewak Sangh, C/o Delhi *Pinjrapole* Society, Katra Tabacco, Delhi	December, 1948
Jaipur State	Jaipur Rajya Gosewa Samiti, C/o Raja Mandal Office, Sikkar, Jaipur State	October, 1946
Orissa	Provincial Federation of *Gaushalas* and *Pinjrapoles*, Orissa, Cuttack	November, 1945
United Provinces	U.P. Federation of *Gaushalas* and *Pinjrapoles*, Naya Tola, Bareilly, United Provinces	May, 1947
West Bengal	Provincial Federation of *Gaushalas* and *Pinjrapoles*, C/o Calcutta *Pinjrapole* Society, Calcutta	December, 1948

(4) *Control over funds:* The main source of income of these institutions is the public charity collected on voluntary basis. In most of the markets a cess called *Dharmada, Laga* or *gaushala Katauti* is deducted on the sale of principal commodities. Depending upon local conditions the rates vary from commodity to commodity and market to market. But unfortunately a substantial part of the money deducted as *Dharmada* is not rightly spent and its actual payment to the *gaushala* funds rests entirely on the discretion of the person who collects. It is, therefore, very necessary that public opinion should be raised against the malpractices prevalent in the collection and distribution of *gaushala* cess. More effective check over the keeping of accounts and expenditure is also very necessary. In some of the provinces efforts are being made to pass legislative measures for the control of the funds and property of these institutions. Experience will show as to the desirability of following such measures in other provinces.

In the end, it may be stated that in spite of many apparent drawbacks and handicaps from which these institutions are suffering, they could, if organized on proper lines, very well serve as useful centres for improvement of cattle and milk production. The financial resources of most of them are ample. Generally these institutions are manned by influential local business community who work with religious fervour and zeal. They have in addition public sympathy. What is needed, therefore, is proper guidance so that they may be put on correct lines and be able to implement effectively the existing efforts in the development of the cattle wealth of the country.

SOUTH AMERICAN PLANTS TESTED IN AUSTRALIA MAY IMPROVE TROPICAL PASTURES

AN expedition sponsored by the U. S. Department of Agriculture in co-operation with the Australian Council for Scientific and Industrial Research visited South America (Argentina, Araguay, Paraguay and S. Brazil) last year. These are the home of many natural pasture legumes. One of the problems of tropical areas in Australia is the inability to establish satisfactory legumes.

About 400 samples collected by the expedition are under observation near Brisbane and the Australian scientists are engaged in the selection of the most promising types for large scale trials.

During 1947, 825 varieties of seeds and plant material were received from 31 overseas countries by the Plant Industry Division of the Commonwealth Scientific and Industrial Research Organization. An equal number of seed samples was sent out. Pasture and forage plants comprised the greatest number of Australia's importations.—*Australian Agricultural Newsletter*, No. AGN/269.

PRODUCTION OF VIRUS-FREE SEED POTATOES

By R. S. VASUDEVA and T. B. LAL

VIRUS diseases of potatoes are prevalent wherever the crop is grown. They not only cause appreciable reduction in the yield but are also responsible for the degeneration of seed stocks. Observations on the prevalence of virus diseases in the hills and plains of Northern India show that the incidence varies in different tracts, but is very high in many places. All the commercial Indian potato varieties have been found to be heavily infected. Most of these diseases are carried in the tuber but diseased and healthy tubers cannot generally be distinguished from each other. The virus symptoms can only be observed on the plant raised from the infected tuber. It is therefore important to produce virus-free potato seed, the use of which will increase the yield of potatoes per acre considerably. The statistical reports from Canada* show that yields secured from certified crop are nearly doubled. The problem of production and multiplication of disease-free potato seed has therefore an important bearing on the 'grow more food' campaign.

Important viruses

Work on the virus diseases of potatoes has been in progress in the Division of Mycology and Plant Pathology of the Indian Agricultural Research Institute, New Delhi, for the last eight years but had received little attention in India during the earlier past and the information as regards the occurrence of viruses in the commercial Indian varieties was meagre. As a result of research at the Institute, the occurrence of six important viruses namely, Solanum viruses 1,2,3,6,8 and 14 (Potato viruses X,Y,A,D,F and Leafroll virus) has been shown. Almost all the plants of commercial potato varieties are found infected with Solanum virus 1. Solanum viruses 2 and 3 commonly occur in combination with Solanum virus 1. To study the reaction of Indian varieties of potatoes to different viruses and for further analytical work it is necessary that the potato variety under experiment be initially free from virus infection. Work to produce virus-free nucleus of two important commercal Indian varieties, namely, *Phulwa* and *Darjeeling Red Round* which would also serve as basis for Seed Certification purposes was undertaken in 1941-42 at Delhi.

Early trials

In the winter of 1941 apparently healthy plants of *Darjeeling Red Round* and *Phulwa* growing in the fields were selected. Seed tubers of these varieties had been obtained from Darjeeling and Patna respectively. The selected plants were bagged and were kept under constant observation for visible symptoms of infection. Any plants which, at one stage or the other, were found apparently diseased were rejected. In February, 1942, the plants were finally selected and their yields stored separately.

Further trials

In 1942-43 season, 54 tubers of *Darjeeling Red Round* and 101 tubers of *Phulwa* raised from the plants selected in the field during the previous season were grown in pots containing well-manured sterilized soil in an insect-proof house. As soon as the plants were about four inches high they were examined every day for visible symptoms and were later periodically tested on differential hosts, e.g. *Nicotiana tabacum* L., *Datura stramonium* L., and *Capsicum annuum* L., for virus content. Four plants of *Darjeeling Red Round* out of 54 plants and 8 plants of *Phulwa* out of 101 remained apparently healthy till the end and also failed to produce symptoms of infection on the differential hosts. The remaining plants of both varieties, however, showed Negligible mottle and were discarded. The

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* Tucker, J. (1937). The value of Seed Potato Certifications to the Potato Industry. *Amer. Potato J.* **14**; 39-45.

yield of the plants which so far appeared disease-free was retained for further tests.

During 1943-44, individual tubers of *Darjeeling Red Round* and *Phulwa* obtained from selected plants were again planted in pots in the insect-proof house. All the tubers from one plant were raised in a unit. The plants from such tubers were kept under observation from day to day and as before tested on differential hosts. In *Phulwa* variety the progenies of all the eight plants selected during 1942-43 exhibited faint mottle, at one stage or the other, which was due to Solanum virus 1. In the case of progenies of five plants, however, one or two plants in a unit were found to be apparently healthy throughout this period though the other plants in the same unit were diseased. These plants produced doubtful symptoms of infection on the differential hosts. Their tubers were therefore retained for further tests.

Production of a virus-free nucleus

In the case of selections of *Darjeeling Red Round* progenies of three plants out of four showed Negligible mottle in 1943-44 and were therefore discarded. All the progenies, numbering 17, of the remaining one plant, however showed no symptoms of disease. The plants had developed vigorous growth with green well-expanded leaves. These were repeatedly tested on the differential hosts but failed to infect them. Grafts were also made on *Datura stramonium, Nicotiana tabacum* and potato variety *Epicure* but no symptoms of disease were observed on any of the test plants.

One lot of the tubers of *Darjeeling Red Round* raised from each of the 17 selections was planted in units in the insect-proof house at Delhi in October, 1944. The remaining tubers were planted in April, 1945 in a well-isolated plot at the Central Seed Potato Certification Station, Kufri (Simla hills), located at 9,000 feet, in order to multiply the material. The plants, raised in the insect-proof house at Delhi continued to be examined and to ensure their freedom from disease, were again tested on the differentials but they proved to be disease-free. The plants showed vigorous and sturdy growth. The origin of these plants is traced to a single parent tuber and they now provide the nucleus for a stock which is proposed to be increased and in time is likely to replace the present infected seed stocks of *Darjeeling Red Round* variety.

PRIME MINISTER ON FOOD

SPEAKING at a luncheon given in his honour at New York by the Overseas Press Club of America, Pandit Nehru said :

'India's primary need to-day is food. In a couple of years we shall be self-sufficient regarding food as we have in hand big multi-purpose schemes, some of them even bigger than the Tennessee Valley project. But our immediate need is tractors, machinery and fertilizers. We want food at prices we can afford. The price structure is governed essentially by the price of wheat. We would like to have some of the surplus wheat of America '.

Pandit Nehru declared that India particularly wanted to create a reserve of wheat so that it could keep down prices in India. 'Secondly, we want machinery and technical assistance. We have technical skill up to a certain degree in India, but what we want is a know-how of the type that America can afford to give us in carrying out our huge development projects.'—*Food Bulletin*, October 24, 1949.

PROTOZOA AFFECTING THE SHEEP AND GOATS IN INDIA

By H. N. RAY

IN recent years the interest of Indian farmers has been directed towards the raising of sheep and goats in the country. Of late several sheep and goat breeding farms have been started in the various parts of the country.

Amongst various diseases, such as bacterial, viral or verminous, the diseases of protozoal origin are of no mean order. In this short note, therefore, an attempt is made to acquaint the farmer as well as the controlling authorities with some of the chief protozoan diseases that are likely to interfere with the normal progress of breeding farms. To define a protozoan is a difficult task but for practical purposes it is sufficient to know that it consists of a speck of living substance, the protoplasm, with a single regulating centre, the nucleus. It is due to this apparently simple organization that the name 'protozoa', which means 'primitive animals', was applied to this group of organisms. It may be mentioned at the very outset that diseases due to protozoa in sheep and goats have received very little attention in India. Excepting a few stray records of some blood and intestinal protozoa from sheep and goats* no serious attempt has so far been made to determine as to how far these organisms are responsible for economic loss to the country. Another object of this note, therefore, is to invite information from the field on various points mentioned in the text.

Coccidiosis

The most important protozoan disease known to affect adversely the sheep and goats, particularly of young age, is coccidiosis. Protozoa of the group *Eimeria* invade the intestinal tract and often produce conditions that lead to the fatal end of the host. Several forms such as, *E. arloingi*, *E. faurei*, *E. intricata*, *E. ninakohl vakimovae*, *E. longispora*, *E. parva*, *E. ah-sa-ta*, *E. granulosa*, *E. pallida*, *E. arkhari and E. crandallis* have been recorded from sheep and goats of various parts of the world. Of these the first four species have been seen by the writer to occur in Indian ovine and caprine hosts. *E. arloingi* is stated to be the most dangerous one which may often cause heavy mortality (20 to 30 per cent or even 60 to 90 per cent) amongst lambs and kids. The disease may appear with the onset of rains and at times persists throughout the year as a stall, or pasture infection. Low-lying wet pastures serve as favourable ground for the persistence of the infective stage—the oocyst. In stall, the infection spreads through the medium of contaminated fodder. Experimental observations indicate that oocysts maintain their viability even after ten months at near-freezing temperature while at 40°C. they perish after an exposure for three days. Inferior quality of food, faulty feeding, faulty weaning, exposure to cold after shearing, complete changes of living conditions as in change of location, transfer to another herd, unfavourable weather and inbreeding are some of the factors that lower the resistance of the susceptible animals and thus promote the rapid multiplication of coccidia in the walls of the intestine. Recovered animals serve as 'carriers' of infection for months and as such they usually do not manifest any symptoms of the disease.

The affected animals show symptoms of the disease within two to four weeks after infection. Appetite is impaired and symptoms of anaemia followed by emaciation soon appear. There is foul-smelling obstinate diarrhœa usually without hæmorrhage. Symptoms of extreme weakness and convulsions also appear in acute cases and within a few weeks the animal dies from exhaustion.

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* Baldrey, 1906 : Iyer, 1933 ; Achar and Srikantiah, 1934 ; Sarwar, 1935 ; Das Gupta, 1935 ; Ray and Raghavachari, 1941 ; Kat, 1943 ; Ray 1938, 1945.

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In lambs death may occur in a few hours. Conclusive diagnosis of the disease can only be made by detecting microscopically numerous oocysts, the potential infective stage of coccidia in the fæces, but the history and the presence of obstinate diarrhœa may lead to a tentative diagnosis. In latter cases confirmatory diagnosis is essential in order to deal with the situation adequately. In certain cases confirmatory diagnosis is not made till post-mortem examination.

A concept that should be helpful to farmers and clinicians concerns host-specificity of the coccidia, or their specific host affiliations. It is now a well-known fact that coccidia of rabbits and birds do not grow in the members of the bovine family, and vice versa.

The farmer can check the spread of the disease if he keeps a vigilant eye on the sanitary and hygienic conditions of his farm. Here are a few important hints: (1) Infected pastures should be closed down for at least six months; (2) litter should not be allowed to accumulate in the stall; (3) fodder should not be allowed to come in contact with the litter-strewn area in the stall and (4) food in the stalls should, as far as possible, be served on raised, clean and dry troughs. Above all, it must be remembered that moist conditions are ideal for the sporulation and preservation of viability of oocysts in the fæcal pellets that infected animals carry to the feed.

In recent years the usefulness of sulphaguanidine in the control of coccidiosis in lambs has been pointed out by Foster, Christensen and Haberman (1941). One to two grams of the drug given daily (with one day interval between each week) for four to six weeks completely stopped elimination of oocysts in the fæces. Sulphamezathine so useful in controlling bovine and poultry coccidiosis may also be found useful in cases of bovine and caprine coccidiosis.

In spite of all that has been said above, control of coccidiosis constitutes a topic difficult from many angles. For example, it is not known, (a) why feeder sheep and goats sometimes experience severe outbreaks; (b) is it the concentration of animals and resulting increase in the chances of heavy infection? (c) or, is it partly the metabolic change attributable to heavier feeding of concentrates that makes the host more susceptible?

Giving due regard to all sides of the problem, the author suggests that data ont he following lines should, in the first instance, be collected in collaboration with the Indian Veterinary Research Institute.

(1) Incidence of coccidiosis in sheep and goat breeding farms in India.

(2) Determination of species of coccidia.

(3) Climatic conditions that favour coccidiosis.

(4) Breed susceptibility of coccidiosis.

Another type of protozoan disease in sheep and goats that may call for attention is piroplasmosis (Babesiasis and Theileriasis).

Babesiasis

The protozoa concerned in this disease are placed under the genus *Babesia*. These organisms invade the red blood corpuscles of the host. The following species have so far been noted to occur in India: *B. motasi*, *B. ovis*, *B. sergenti*, *B. taylori* and *B. foliata*. *B. motasi* infection in sheep produces symptoms which are very much similar to those of 'red-water' in cattle. There is fever, loss of appetite and profound anæmia. The urine becomes coffee-coloured. In *B. foliata* infection in sheep, however, hæmoglobinurea is absent but high fever, anæmia and deterioration of general condition are well-marked. Pathogenesis due to *B. taylori* infection in goats is doubtful, while *B. sergenti* and *B. ovis* are not known to produce recognizable symptoms. The dropping-off tick, *Rhipicephalus bursa*, is the transmitting agent of *B. motasi* in Rumania, but as this tick is not known to occur in India, attention may be diverted towards some other species of ticks.

Theileriasis

On rare instances infection in sheep and goats with *Theileria ovis* and *T. hirci*, has been recorded from India. In natural cases in Serbia, *Rhipicephalus bursa* is suspected to be the transmitting agent. With regard to India no information is available till now.

Whether or not piroplasmosis is a major problem for sheep and goat breeding farms in India is a question which requires thorough investigation. It is therefore recommended that information on the following points be collected in collaboration with the Indian Veterinary Research Institute.

(1) Incidence of piroplasmosis in sheep and goats.

(2) Determination of species of protozoa concerned.

(3) Determination of arthropod vectors.

Surra

Occasional outbreaks of surra due to *Trypanosoma evansi* infection is not an uncommon occurrence amongst sheep and goats in India. Affected animals show progressive anæmia and emaciation while the body temperature remains normal to sub-normal. Appetite is never impaired. Death is sudden and comes within two to three weeks after infection. Breeding farms located within a surra zone shall always be exposed to the possibility of infection spreading to the farm when the surra season is on. Adoption of fly control and prophylactic measures well in advance of the expected surra season will be found to be very helpful in avoiding any calamity.

Species of *Anaplasma*, *Bartonella* and *Grahamella* have often been encountered in the routine examination of blood smears of sheep and goats in this Institute. Whether they play any pathogenic role or not is a point which has yet to be elucidated. However, it is important that data concerning the incidence of these organisms in various sheep and goat breeding farms in India be accumulated in order to signify further action.

In conclusion it may be emphasized that the Indian farmers should come in close contact with their fellow brothers working in the laboratory and with mutual cooperation help to build up a fund of knowledge that will serve as a guiding force for the eradication of diseases from the country. Almost all the provinces in India have now their own officer specially deputed to investigate disease problems in sheep and goats and a reference to the respective Animal Husbandry Department will bring this special officer in direct contact with the disease problems, who in return, if necessary, will invite expert opinion on the subject. The village *panchayat* can thus form a very useful link between the stock-owner on one hand and the laboratory worker on the other. Needless to say that a great uphill task yet remains to be fulfilled before we are in a position to view the situation in proper perspective.

AUSTRALIAN FIELD BEAN FERTILIZER TRIALS

TRIALS with field bean crops in the New England and district of New South Wales, Australia, have shown that yields can be trebled by application of various fertilizers and elements.

A trial on granite soil was sown on 3 × 3 × 3 factorial design, with three levels each of nitrogen, superphosphate and potash, and with split plots of molybdenum and no molybdenum. The only significant increases in yield were obtained from superphospate and molybdenum.

The 2 cwt. dressing of superphosphate gave an increase of 2·1 bushels over the 1 cwt. dressing, while a 3 cwt. dressing gave an additional increase of 2·9 bushels. Sodium molybdate at 3 lb. to the acre gave an increase of 3 bushels to the acre. Yield in the different plots ranged from 34 to 42 bushels an acre, nearly three times the normal yield.

On red basalt soil, none of the minor element treatments, either with or without lime, gave worthwhile increases in yield. A minor element trial on grandiorite soil showed increased yields from borax and molybdenum treatments, but lime applications had little effect.—*Australian Agricultural Newsletter*, No. AGN /265.

COMMERCIAL POULTRY FARMING—AN UNECONOMIC PROPOSITION IN ASSAM

By B. K. DAS

POULTRY farming on a commercial scale has not, so far, been a success in Assam, due mainly to higher production cost of eggs and birds in a farm as compared to the price of marketed village products.

Handicaps like high rainfall, high incidence of disease, high wages of local labour, dearth of foodstuffs, etc. have also been responsible to some extent for the failures. These factors are discussed briefly below with the help of data obtained from the records of A.O.C. Farm, Digboi, and Government Farms of Assam.

Market price of eggs and birds in Assam

The price of eggs and birds varies from season to season in Assam and is generally lowest during the cold season and highest from August to October, the difference in price being as much as 50 per cent.

Depending on availability and locality, fowl eggs sometimes fetch slightly higher price than duck eggs. But duck eggs are more in demand as they give more food value per rupee (average weight of duck eggs is $1\frac{3}{4}$ oz. and of fowl eggs is $1\frac{1}{2}$ oz.), and are preferred by the majority of the population, the Hindus.

Fish is a strong competitor against eggs and birds in this province and its availability has a direct influence on the demand and prices of these foodstuffs.

Within these limitations and variations, the average wholesale price of eggs and birds in the urban markets of Assam valley from 1942 to 1947, is given in Table I.

To compare with these prices, the cost of production of eggs and birds in a farm have been taken from the records of A.O.C. Farm, Digboi. The cost of same in Government Farms of Assam will be similar, if not higher.

Cost of production of eggs

In computing this the feed cost per laying bird over a year plus cost of labour and upkeep and average yield of eggs per bird per year have been taken into consideration.

TABLE I

Average wholesale price of eggs and birds (1942–47)

Year	Price of 100 eggs. Average for the year		Price per fowl (table size). Average for the year		Price per adult duck. Average for the year		Remarks
	Rs.	as.	Rs.	as.	Rs.	as.	..
1942	4	8	1	2	1	4	
1943	7	0	2	0	2	4	Prices went high due to war
1944	9	8	2	14	3	0	do.
1945	9	8	2	14	3	0	do.
1946	7	8	2	0	2	0	do.
1947	7	8	1	8	1	12	Price of eggs fluctuated very much due to transportation difficulties

Feed: Feed given to each bird daily has been 2 oz. paddy as scratch food and 2 oz. of the following mixture as mash using as far as practicable only those foodstuffs which are common in Assam.

Mixture

1 part wheatbran
1 part broken rice
1 part crushed *matikalai* (black gram or *urd*)
5 per cent fish meal or dried fish or boiled meat scrap
$2\frac{1}{2}$ per cent mineral mixture and grit

The average prices of these foodstuffs and of the above-mentioned mixture for the five years 1942 to 1946 are given below. The value of green feed which has been mostly farm grown

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lettuce and vegetable leaves, has not been taken into account.

TABLE II

Average price of foodstuffs and grain mixture (1942-46)

	1942		1943		1944		1945		1946		Remarks
	(Per maund)										
	Rs.	as.	Rs.	as.	Rs.	as.	Rs.	as.	Rs.	as.	
Paddy	4	0	6	0	7	8	7	8	7	8	
Matikalai (crushed)	6	8	11	0	15	0	15	0	12	0	
Wheatbran	5	8	5	8	5	8	5	8	8	0	Direct import from Calcutta
Broken rice	6	0	9	0	12	0	12	0	10	0	
Fish meal or meat scrap	20	0	30	0	40	0	40	0	40	0	
Mineral mixture	15	0	15	0	18	0	18	0	18	0	
Feed mixture	6	13	9	9	12	0	12	0	11	3	

When wheatbran went out of stock ricebran was substituted, but as price of the latter ranged between Rs. 3-8 to Rs. 5-8 per maund, there was little saving of money on that score.

Cost of labour : This has been calculated on the basis of one man for 200 birds, based on the author's experience in the A.O.C. Farm, Digboi. His duty includes :

(1) Cleaning of 10 houses (with 20 birds in each) with attached runs and also feeding utensils once daily. Time taken 4½ to 5 hours usually.

(2) Bringing food from godown and feeding the birds four times daily (scratch food twice, once dry feed and once mash).

(3) Collecting vegetable and lettuce leaves from the field for feeding the birds.

(4) Collecting eggs, several times in a day.

(5) Hoeing one of the runs by turn every day for burying the soiled surface of the runs.

(6) Attending sick birds, when necessary.

All these duties usually keep the man fully employed for the day.

Allowance has to be made over and above this for sickness (in a malarious country like Assam), leave, Saturday and Sunday overtimes, etc.

Wages of an ordinary labourer during the five-year period, 1942 to 1946, have been as follows :

		Rs.	as.	
1942	...	1	0	per day
1943	...	1	4	,, ,,
1944	...	1	8	,, ,,
1945	...	1	8	,, ,,
1946	...	1	8	,, ,,

Cost of rearing males : As the selling of setting eggs and breeding stock were also included in the programme of the farm, the cost of rearing male birds has also to be taken into consideration. For producing table eggs only this expense could be dispensed with except when suitable replacements for culled birds were unavailable locally. In Digboi almost all the improved hens were mated, but in a big commercial farm mating of more than 50 per cent of the birds may prove to be unnecessary. Taking this figure as the basis for calculation and taking that one cock will be needed for every 10 hens in the average, (light and heavy breeds combined), the cost of feeding and labour for males comes up to 1/20th of that of hens in a year. The cost of production of eggs will, therefore, increase in the same proportion.

Cost of replacement of laying stock : The economic life of a laying hen is rather short, rarely more than three years, often less, the best laying periods usually being the 'pullet' and the succeeding year. Hence, replacement of stock is essential at least every third year. In actual practice this is a gradual process, averaging, say, one-third of the total stock per year and is always attended with some loss as the disposal value of the birds is usually far below their initial price. An idea of this loss will be obtained from the following figures : Stock maintained say, 100 hens. Initial cost @ Rs. 5 each = Rs. 500. Transactions at the time of replacement :

Receipt		Expenditures
Value of 33 hens culled out @ Rs. 2 each	= Rs. 66	Cost of 33 hens as replacement at the end of the year @ Rs. 5 each = Rs. 165
Loss in a year	= Rs. 99	
	Rs. 165	

It is therefore seen that for every 100 hens maintained in the farm, there is a loss of about a rupee per bird per year at the time of replacement.

Other charges : These include remuneration of Supervisor, medicines, rents and taxes, interest on capital, depreciation on houses, etc.

In A.O.C. Farm, Digboi, where more than 1,200 birds were kept at any given time, for about three years, these charges have been found to be Rs. 2-4 or so, per bird per year.

Actual expenditure was calculated as follows :

(a) Remuneration of Supervisor @ Rs. 65 per month		...Rs. 780
(b) Medicines ...		...Rs. 80
(c) Rents and taxes on 20 acres @ Rs. 4-14 per acre		... Rs. 97-8
(d) Interest on capital :		
(i) Value of 1,200 birds @ Rs. 4 average	= Rs. 4,800	
*(ii) 60 houses and runs, bamboo and thatch, @ Rs. 80 each	= Rs. 4,800	
*(iii) Staff quarters, bamboo and thatch	= Rs. 1,200	
(iv) Equipments	= Rs. 300	
	Rs. 11,100	
@ 3 per cent (Savings account interest)		... Rs. 333
(e) Repairs and depreciation on houses, (average life of thatch when cane or similar leaves are used, eight years; of bamboo walls of poultry houses with proper caves, five years; of bamboo posts, one year; and of bamboo fence of runs, when fixed 2 in. to 3 in. above ground, three years; average life of all items combined about five years) say, 20 per cent of the cost		= Rs. 1,200
(f) Miscellaneous (including loss from breakage of eggs between laying and marketing)		= Rs. 200
		Rs. 2,690-8

Rs. 2,690-8 ÷ 1,200=about Rs. 2-4 per bird per year.

Loss arising out of deaths and casualties : Even in very well-managed farms, death stalks in and casualties occur in spite of all precautions. Losses through these two factors are variable and may reach up to 10 per cent or more of the stock in some cases, but under normal conditions and under favourable circumstances, it should be possible to keep them down to 5 per cent or less. Taking this latter figure as the basis for calculation, it is seen that for every 100 birds, there is a loss of about Rs. 25 per year, @ Rs. 5 per bird. It works out at four annas per living bird per year.

Total cost of upkeep

The total cost of upkeep for a hen over a year during 1942 to 1946 is given in Table III after adding up the above-mentioned items of food, labour and other charges.

TABLE III

Cost of upkeep of a hen (1942-46)

Year		Cost of food	Cost of labour	Proportionate cost of rearing males	Cost of replacements	Other charges	Loss through death and casualties	Total
		Rs. as. p.	Rs. as. p.	Rs. as. p.	Rs. as. p.	Rs. as. p.	Rs. as. p.	Rs. as. p.
1942	...	6 1 3	1 13 0	0 6 3	1 0 0	2 4 0	0 4 0	11 12 6
1943	...	8 12 0	2 4 6	0 8 9	1 0 0	2 4 0	0 4 0	15 1 3
1944	...	10 15 6	2 11 0	0 10 9	1 0 0	2 4 0	0 4 0	17 13 3
1945	...	10 15 6	2 11 0	0 10 9	1 0 0	2 4 0	0 4 0	17 13 3
1946	...	9 13 6	2 11 0	0 10 0	1 0 0	2 4 0	0 4 0	16 10 6

Yield of eggs

The average annual yield of eggs per bird for the years 1937-38 to 1945-46, have been taken from the records of the A.O.C. Farm, Digboi, and from those of the Government Farms of Assam and are given below :

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* All houses were made of bamboo and thatch, because it was cheap and rearing poultry was an experimental and war-time enterprise.

TABLE IV

Average annual yield of eggs per bird

	1937–38				1938–39				1939–40				1940–41				1941–42				1942–43				1943–44				1944–45				1945–46			
	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks	Rhode Island Red or White Leghorn	Crosses	Local Hens	Ducks
A.O.C. Farm Digboi	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	113	×	67	*45 *(in 4 months)	114	76	66	89	106	72	40	76	123	67	×	×	112	81	×	×
Upper Shillong Farm	150	138	×	×	115	108	70	81	Record unavailable				132	×	×	×	×	×	×	×													124	×	×	×
Sylhet Farm	×	×	×	103	×	×	×	60	do				×	×	×	×	×	×	×	×													100	×	96	×
Khanapara Farm	×	×	×	×	97	×	×	87	do				×	×	×	×	×	×	×	×													96	87	63	81
Pukra Duck Farm	×	×	×	×	×	×	×	70 (in 6 months)	do				×	×	×	130	×	×	×	×													×	×	×	150
Titabar Farm	×	×	×	× ×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×													87	×	×	×

Note: All laying records of Government Farms have been taken from the *Annual Reports* of the Agricultural Department of Assam. No report was published for the years 1941 to 1945.

The average yield per bird per annum thus comes to :

Rhode Island Red or White Leghorn ...	113
Crosses	90
Local hens	67
Pukra farm ducks	140
Local ducks	79

The yield of 113 eggs per year from an improved hen in Assam is lower than that obtained in farms of Northern India, where the average annual yield per hen reaches up to 140 in some cases. It is extremely doubtful if the yield of eggs in Assam will ever equal that of Northern India.

However, for the sake of comparison, both the figures of yield, viz. 113 and 140 are taken into consideration in the following Table for calculating the cost of production of 100 fowl eggs during the years 1942-46. Market prices of eggs of the respective years are also shown side by side for reference.

TABLE V

Cost of production of hundred fowl eggs during 1942-46

Year	Annual total cost of up-keep per hen			Cost of 100 eggs @113 eggs per year			Cost of 100 eggs @ 140 eggs per year			Average market price for 100 eggs		
	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.
1942	11	12	6	10	6	3	8	6	3	4	8	0
1943	15	1	3	13	6	0	10	12	0	7	0	0
1944	17	13	3	15	12	3	12	11	9	9	8	0
1945	17	13	3	15	12	3	12	11	9	9	8	0
1946	16	10	6	14	11	9	11	14	3	7	8	0

From the foregoing Table it is seen that, during the quinquennium mentioned, the cost of production of eggs is higher than the market price by almost 100 per cent in the case of 113 egg yield and by exactly 50 per cent in the case of 140 egg yield per hen per year. The difference/loss in both cases is very high and is normally insuperable under Assam conditions even if the bigger size of eggs from exotic birds and higher price of setting eggs are taken into consideration.

These two points are now discussed in detail below :

Bigger eggs from exotic birds : These eggs are bigger than local hen's eggs, but are usually no bigger than duck's egg. In special markets, like that of Digboi or Shillong where there are many European buyers, a limited number of these eggs can sell at a higher price, specially as the supply is very limited at present. But ordinarily these eggs will have to contend with three factors :

(i) The limited buying capacity of the majority of the local inhabitants;

(ii) the allurement of cheapness of the local hen's eggs in spite of their comparatively smaller size ;

and (iii) competition from cheaper duck eggs which are as big as exotic hen's eggs and are quite liked by all sections of the inhabitants for table purpose.

During the years of his management of the A.O.C. Food Stall in the Digboi bazar, the author has repeatedly found that even the Mohammedan buyers, rich or poor, preferred duck eggs to fowl eggs for ordinary daily use, due to the greater value the former gave for their money. They are likely to employ the same monetary standard when making their choice between cheaper duck eggs and dearer fowl eggs of equal size. The result will be lesser demand for the latter. Moreover, with the dwindling of the European population with their greater buying power the fancy price of exotic hen's eggs is also likely to disappear.

Higher price of setting eggs : Eggs for setting no doubt fetch higher price, but what will be that price, specially when more than one farm operate in the same area ? And what percentage of the production can be sold as such ? Will the proceeds be enough to cover the expenses incurred in producing the eggs ? These points are now discussed one by one.

(i) *Price :*

The A.O.C. Farm sold eggs for setting to the inhabitants of Digboi @ as. 4 each from 1941 to 1945, when the market price of table eggs ranged between one anna and three pies to one and half anna each. The price of setting eggs in Government Farm varied between as. 4. to as. 8 each for urban buyers according to demand and availability. A price higher than as. 4 per egg was found to be beyond the reach of the local inhabitants in general and so in mass production of setting eggs higher price expectation will be unjustified.

(ii) *Percentage of production that can be sold for setting :*

In Assam, the demand for setting eggs is more in the cold season which is propitious for hatching and when the eggs possess more vigour and fertility and also retain them longer.

In a commercial farm in Assam, where hatching season is limited by rainfall and climate; about 30 per cent of the yearly production, i.e. nearly all the fertile eggs produced in the cold season (November to February) may, *at the very most*, be expected to be sold as setting eggs.

(iii) *Sale proceeds of setting eggs* versus *production cost :*

It has been seen that cost of production of table eggs exceeds market price by about 100 per cent under Assam conditions. In order to recoup this loss, the number of eggs sold for setting must of necessity be at least 40 per cent of the total production (which is 10 per cent higher than actual availability) and their price should not be less than Rs. 25 per hundred. Even then, profit for the owner would remain unrealized, for which selling of about 60 per cent of the eggs as setting would be needed. But this is too great an expectation in Assam, as season, climate, local market conditions and possible competition are all against it.

Cost of production of duck eggs

The cost of feeding ducks which consume about 2 oz. more food per head daily is about 50 per cent higher than that of fowls and as ordinary ducks yield about 30 per cent less than improved fowls, the overall cost per 100 duck eggs is enhanced by almost 100 per cent when compared to that of fowl eggs. Even when the yield of duck eggs in Pukra Duck breeding station is taken into account (140 eggs per bird per year) the cost of duck eggs remains about 10 per cent higher than that of fowl eggs. Under farm conditions ducks have been further found to produce greater number of infertile eggs and to be more susceptible to nutritional diseases and changes of food and environments.

Thus it is seen that production of eggs, either of improved fowls or of ducks, in a commercial farm in Assam, is an uneconomic proposition even when bigger size of eggs from exotic birds and higher price of setting eggs are taken into consideration. The position would be far worse if local or mixed breeds with lower laying capacity were also kept in the farm.

Cost of production of table birds or breeding stock

In calculating this the following items have been considered :

(1) *Cost of setting eggs :* In the A.O.C. Farm, Digboi, it averaged as. 2-3 each during 1941-45. It is quite a reasonable figure of cost for eggs produced in a commercial farm in the province.

(2) *Hatchability of eggs :* Normal hatchability of eggs was 70 per cent in the case of hen's eggs and 50 per cent in the case of duck eggs. This lesser hatchability increased the cost of setting egg by more than 6 pies.

(3) *Cost of incubation :* This worked out at about as. 2 per chick hatched out when a broody hen was used for hatching. This is arrived at by dividing the feed cost of the bird (about Re. 1 for a month) by the number of chicks (average 7 to 8 hatched out per setting). The cost of machine incubation will be equal to it, if not higher.

(4) *Mortality in chicken :* This is usually 40 per cent (often more) from birth up to adult age due mostly to too wet climatic conditions, chicken pox and faults in the foster-mother. It adds up to the cost of production of the surviving birds. Most of the deaths occur before the chicks have reached three months age, when cost of feed is lesser than in the subsequent period. Therefore, under normal conditions, the monetary loss is estimated at roughly 10 per cent of the total cost of upkeep of the surviving birds.

(5) *Feed cost :* The calculation of this is based on routine employed in the A.O.C. Farm, Digboi, and is as follows :

For 100 chicks	Feed given	Value
		Rs. as. p.
3rd day after birth to 10th day	Average 3 lb. daily of 2 parts broken rice and 1 part wheat-bran	2 10 0

For 100 chicks	Feed given	Value Rs.	as.	p.
	Brought forward	2	10	0
11th day to 3 months age or 90th day	Average 9 lb. daily of 2 parts broken rice, 1 part broken *matikalai*, 1 part wheatbran and 5 per cent fish meal	103	1	0
3 months to 8 months age	Average 12 lb. daily of adult feed mixture and 6 lb. daily of paddy as scratch food	305	2	0
	* Total Rs.	410	13	0

Rs. 410-13-0 ÷ 100 = about Rs. 4 per bird up to 8 months age. Value of greens have not been taken into account as these were mostly offals of the vegetable plots of the farm and cost nothing except the labour of collection.

(6) *Labour cost and other charges:* Labour cost is slightly more in the case of young and growing birds as they need proportionately more care and attention than adults. But, in their case other charges are on the other hand low, as interest on capital and depreciation on houses are less applicable because, farm-bred birds have no purchase-value, and need for less space than adults for most of the growing period. Now, an adult bird costs about Rs. 4-8 in labour and other charges per year (Table III). At this rate it will cost Rs. 3 in 8 months. With this figure in mind, it is estimated that from birth to 8 months age a farm-bred bird will cost roughly Rs. 2-8 in labour and other charges.

All the above-mentioned items added together, bring up the cost of production per bird to about Rs. 7-8, calculated as follows:

		Rs.	as.	p.
(a)	Cost of setting eggs	0	2	3
(b)	Increase in cost of hatching due to infertility of eggs	0	0	6
(c)	Cost of incubation	0	2	0
(d)	Feed cost	4	0	0
(e)	Labour and other charges	2	8	0
(f)	Increase in cost due to mortality, 10 per cent of the total costs in items (a) to (e)	0	10	9
	Total Rs.	7	7	6

or say, Rs. 7-8 per bird at 8 months age.

The average market price of table birds is Rs. 2-8 in this province. Compared to this, the cost of production of a farm-bred bird is three times as high and is an entirely uneconomic proposition for table purpose. In the case of breeding stock, the average sale price of a farm-bred cockerel was Rs. 7-8 and of a pullet Rs. 5 in the A.O.C. Farm, Digboi, for individual buyers during 1941-45. When cockerels were sold in numbers to the tea estates the wholesale price was between Rs. 5 and Rs. 6 per bird. Birds sold from Government Farms equalled these prices mostly, or were sometimes more in special cases. The above prices were fair and still hold good. Thus it is seen that in Assam, the selling of farm-bred birds as breeding stock is not also likely to bring any profit to the owners.

Handicaps

The chief handicaps are the following:

(1) Heavy rainfall (112 inches average over the province), spread over about eight months in the year, which hinders the range-feeding and general well-being of the birds.

(2) Diseases, most common being internal and external parasites which thrive very easily in the equable climate of the province. Other diseases to be dreaded are Ranikhet, Fowl-cholera and Chicken-pox, Paralysis of legs, cannibalism and eating of eggs are also common when there is defective nutrition.

(3) Dearth and high prices of foodgrains, such as paddy, broken rice and *matikalai*, which are also essential human necessities. From the national point of view too, it is uneconomical to feed these foodgrains to

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* All calculations have been made according to average price of foodstuffs for 1942-46 as per Table III.

poultry in preference to human beings as the calorific value of these foods, when fed to the birds, is not recovered in their eggs or meat. The following comparison of calorific values of foodgrains, egg and meat will illustrate this.

Calories in foodgrains given per year to each bird				Egg produced by each bird	Meat for table per improved fowl	Meat for table per Indian duck
Paddy 45 lb., i. e. rice 32 lb. @ 99 calories per oz.	Rice 15 lb. @ 99 calories per oz.	*Matikalai* 15 lb. @ 96 calories per oz.	Total per year	113×2 oz. @ 42 calories per oz.	3 lb. @ 30 calories per oz.	3 lb. @ 50 calories per oz.
50,688	23,760	23,040	97,488	9,492	1,440	2,400

(All calorific-values taken from *Food* by Robert McCarrison).

It is seen that by ingesting 97,488 calories poultry can produce only either 9,492 in eggs or 2,400 in meat. Maximum total utilization is therefore only about 12 per cent of the intake, the rest being wasted.

(4) Cost of high wages, augmented by the irregular attendance and inefficiency of the local labour.

Conclusion

From the foregoing discussions regarding the market price of eggs and birds, their production cost in the farms and the handicaps, the hard fact emerges that in Assam a commercial poultry farm has to struggle against heavy odds and has practically no chance of success under the existing conditions.

The author therefore feels that the interest of the province would be best served by encouraging and improving village products, by providing facilities for timely inoculation of improved stock and by organizing speedy and safe transport for eggs and birds during their transit from rural to urban areas.

TWIN CHICKENS FROM DOUBLE-YOLKED EGG

A BOYHOOD ambition to hatch twin chickens from a double-yolked egg has accidentally been achieved by an Australian poultry farmer. He estimates that getting twin chickens is a million to one chance.

The farmer is Robert Wilson of St. Ives, New South Wales, who has hatched 500,000 chickens. In August 1949, while handling eggs from an incubator, Mr. Wilson was surprised to see one egg chipped on both sides. He handled the egg carefully and gave the chicks a little help to break the shell. Now he has twin Chinese Langshan chickens. They are abnormally small and are being mothered by a hen.

The twin chickens came from a brown-shelled egg weighing 2-3 /4′ oz. Chick sexers say that double-yolked eggs usually weigh about four ounces but it is rarely that both yolks are fertile.—*Australian Agricultural Newsletter*, No. AGN /265.

ECONOMICS OF POULTRY-KEEPING

By S. G. IYER

IN India at present there is no system of guaranteed prices and promising markets for eggs and poultry nor is there any exhaustive periodical bulletin giving publicity of the current economic position, as an aid to the fixation of prices. Prices for eggs and table poultry are not controlled, the farmer gets very little profit for his produce and the middleman makes the best of the business by exploiting the consumer. A good deal of useful work in the line is being undertaken by the Marketing Departments and there is considerable scope for improvements. Price fixation of eggs or poultry demands accurate knowledge of the production costs. In the absence of systematic surveys on regional basis, the country being extensive, it is indeed difficult to quote accurate figures with respect to rearing, feeding and other costs of production. On specialized farms budget figures have to be announced as forecasts and it is becoming more and more important to institute cost accounts dealing with the different aspects of poultry husbandry separately. Where poultry are kept as a side line to other livestock or agricultural enterprise it is still more difficult to assess labour and other costs. Experience has shown that there is an ocean of difference between the present costs and pre-war costs. To contribute some reliable information on the current costs of production of eggs, the records (1945-46) of the Poultry Research Section of the Indian Veterinary Research Institute, Izatnagar have been analyzed and the data collected form the basis of this article.

Stock

Rhodes being hardy and dual-purpose breed, the records of this breed have been considered. Pure-bred and pedigreed ready-to-lay pullets were trapnested for a period of 365 days. They were housed in angle iron bar wire-netted houses protected from sun and rain by *chuppers*. The birds selected for the experiment were bred on the Institute Farm from an Australian strain imported in 1939.

The pullets hatched in the month of January, came into lay in August or September; from November onwards cock birds were added to the pen of pullets with a view to produce fertile eggs and flock mating was practised.

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Management

The birds were fed grain and mash rations together with protein, mineral and green supplements and the composition of the cereal rations fed throughout the period, i.e. from the time the birds laid the first egg to the end of the first year's production is as follows :

Mash		*Parts by weight*
Wheat bran	...	35
Yellow maize meal	...	35
Ground oats	...	10
Groundnut cake	...	19
Salt	...	1

Grain mixture

Yellow maize grit Paddy *Jowar*	equal parts

Half the mash mixture was fed as dry mash in waste-proof hoppers to which the birds had free access. The remaining half was fed as wet mash by adding to the dry mash cooked meat offal 1 oz. per bird. The grain mixture was broadcast on the ground morning and evening. In addition all the birds were given *ad lib* limestone grit of suitable sizes and available greens at the rate of about two ounce per bird.

Cost of production

The post-war data (1946) furnishing the cost of production are shown in Table I.

To give a true picture of the actual costs, a correction has been made by eliminating the birds which died before the end of the first year. Actually the mortality for one year amounted to five per cent only.

All eggs produced during November to March were used or sold for hatching while those laid during the remaining portion of the year were sold for table. Loss of eggs due to accident or other factors was less than 0·5 per cent and has therefore been ignored in the calculations.

TABLE I

Costs and returns from pullets

Expenditure			Returns	
Item	Quantity	Total cost of production Rs. as. p.	Item	Cost Rs. as. p.
Ready-to-lay pullets	50	300 0 0	Table eggs 4,000 @ Rs. 1-8 per dozen	500 0 0
Cock birds	4	60 0 0	Hatching eggs 4,000 @ as. 8 per egg	2,000 0 0
Rent of land	1/4 acre	6 0 0	Sale of cock birds	60 0 0
Depreciation of fencing, house and equipment at 10 per cent per annum		47 12 0	Sale of hens after deducting depreciation	240 0 0
Depreciation of hoppers, fountains and trap-nests at 20 per cent per annum		18 0 0	Manure	5 0 0
Depreciation of *chupper* at 50 per cent per annum		25 0 0		2,805 0 0
Food*		884 5 0		
Labour charges—feeding, egg recording and other work		54 0 0		
Cleaning and disinfection		27 0 0		
		1,422 1 0		

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* Details are given in the Appendix.

Results

Table I gives the costs of production and returns from 50 Rhode Island Red pullets. The total cost of production of approximately 8,000 eggs during a period of one year from the 50 birds after deducting the usual depreciation charges on permanent structures, works out to Rs. 1,422. The cost, therefore, per dozen of eggs, fertile as well as infertile, under the experimental conditions is Rs. 2-2 although in some of the cities such as Naini Tal, Delhi, Madras, Bombay and Calcutta there is good market for eggs, the retail prices ranging from Rs. 2 to Rs. 3 per dozen. The producer hardly gets more than Rs. 1-8-0 per dozen on wholesale basis. This is the situation when purebred pedigreed birds have been maintained for purposes of commercial, i.e. table egg production. At this rate producing eggs solely for table may not be a profitable concern under specialized farm conditions but the situation can be improved. At least 50 per cent of the total annual production should be in the form of fertile eggs and this number can be readily obtained during the peak production period between November and

March, the breeding season in Northern India. Temperton* in a study of post-war costs of turkey production stated that food represented a major item of expenditure constituting 50·4 per cent and 44·1 per cent of the total cost of production in first and second hatches respectively. He analyzed also the cost of day-old poults and labour: about 32 and 14·5 per cent respectively. In the present experiment the food costs amounted to Rs. 884 or 62 per cent of the total cost of production. The cost of the birds works out to 25 per cent of the total cost of production and in the absence of authentic information on rearing costs it is hard to conceive that if one starts from purchased eggs at Rs. 12 or so per dozen it would be more profitable than purchasing ready-to-lay pullets. In the figures quoted in Table I a sum of Rs. 6 has only been paid as the cost per pedigreed pullet which in the opinion of the writer is, however, reasonable. Labour charges account for slightly less than 4 per cent of the total cost of production.

At the end of the first year of production the general practice on specialized farms is to retain 1/3 of the layer population which had laid well and dispose of the remaining birds for breeding or table purposes. The layers after one year of laying have therefore a resale value, same in the case of cock birds. A small amount can also be realized from the sale of manure. Not taking into account the sale value of the birds and manure, the return from the sale of eggs, table as well as hatching, is Rs. 2,500 against the total cost of production of Rs. 1,422, which means a definite net profit. On the other hand if all the eggs produced were sold as table eggs only, the total amount that could be realized from the produce would be only Rs. 1,000 leading to a net loss of Rs. 422 although a sum of Rs. 305 could be realized from the sale of birds, etc. The greater the number of hatching eggs sold in the season the greater will be the profit.

Issue of permits for cereals to recognized poultry-keepers and campaign to put an end to black markets will, it is hoped, help a long way to cut down the food costs. The system of feeding in this experiment is an ideal one for getting maximum production. Any departure from this, with a view to cut down the costs in all probability, will adversely affect the production. With small holders or back-yard poultry-keepers, poultry-keeping costs little as in such cases indeed no account is made for fallen grains, insects, greens, house scraps, etc. to which birds usually have access and free labour which is usually available from the wife or the children in looking after the birds.

Summing up poultry farming can be made an economic proposition in this country by producing eggs for table as well as for hatching purposes.

APPENDIX

Food costs

	Rs.	as.	p.
Wheatbran 875 lb. @ 10 lb. per rupee	87	8	0
Yellow maize meal 875 lb. @ 8 lb. per rupee	109	6	0
Oats 250 lb. @ 6 lb. „ „	41	10	0
Earthnut cake meal 475 lb. @ 5·4 lb. „ „	87	8	0
Salt 25 lb. @ 8 lb. „ „	3	1	0
	329	1	0
Grain			
Jowar 833 lb. @ 10 lb. per rupee	83	5	0
Yellow maize 833 lb. @ 8 lb. per rupee	104	2	0
Paddy 833 lb. @ 6 lb. per rupee	138	13	0
	326	4	0
Limestone 1,000 lb. @ Rs. 2–8 per 80 lb.	31	4	0
Meat offal 1,250 lb. @ Rs. 0–1–3 per pound	97	11	0
Greens 2,500 lb. @ 25 lb. per rupee	100	0	0
	228	15	0
Total	884	4	0

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* Temperton, H. (1947). *Harper Adams Utility Poultry J.*, **32,** 4-8

CARDAMOM RESEARCH

THE Indian Council of Agricultural Research is financing a scheme which is calculated to give scientific assistance to the cardamom industry in Madras Province. It came into operation on 1 April, 1944 and is due to terminate on 30 September, 1952. The object is to devise ways and means of controlling the pests and diseases of cardamom and thereby restore the yields to normal. The yield of cardamom is said to have deteriorated from an average of 100 lb. per acre to 35 lb. or less making the cultivation of the crop unprofitable.

Pests

The major pests of cardamom are 'Thrips' which produce scab on the pods. They are also suspected to cause shedding of pods and also to play the role of the insect vector concerned in the transmission of mosaic disease of cardamom. Of the several insecticides tried to control 'Thrips', Nicotine sulphate as a spray and Gammaxene as dust applied once a month proved most efficient and economical.

Another insect pest of cardamom is a caterpillar boring into the shoots and pods. A third one is the swarm caterpillar which defoliates the plant. These are under investigation.

Diseases

'Clump rot' (falling off) disease of cardamom has been found to be caused by a fungus known as *Pythium vexans*. Measures to control the disease have revealed that ammonium phosphate and superphosphate help to arrest the disease and induce quick recovery of the diseased clumps.

Cardamom grown in certain regions of the province under certain conditions appears to be susceptible to 'Mosaic' caused by virus. It is proposed to study various aspects of this virus disease in future.

Nursery practices

Investigations on the nursery practices such as the effect of the soil texture on germination and stand, pre-treatment of seed on germination, most suitable mulch for the primary nursery, effect of dressing of seeds with fungicides on germination, etc. were also studied. The following results were obtained:

(1) The application of cattle manure and ash to the nursery resulted in more vigorous and taller seedlings.

(2) Treatment of seed with 0·1 per cent mercuric chloride for 15 minutes gave significantly better germination.

(3) Of the various types of mulch tried for the primary nursery, grass mulch proved the best and the final stand under this treatment was significantly high.

Breeding

Selection was made with a view to produce strains with higher yield, and other desirable characters such as thick round pod, high oil content, etc. The oil of cardamom is very valuable in commerce and medicine.

The oil content of five of the high yielding selections is given below:

Selection No.	Percentage oil	
	Dry weight basis	Wet basis
10 ...	3·63	1·20
56	2·90	0·87
78 ...	3·70	1·02
87 ...	3·60	0·99
88 ...	2·40	0·72

The above figures show a wide range of variability in the oil content and the selection is in progress for this character. As regards yield, eight selections have been consistently better than the controls in three successive seasons. The percentage of increase in their yield over the local variety of cardamom is given below:

Selection No.	Average percentage of increase over local in three seasons
39	32
Ceylon	35
41	44
89	55
81	111
71	132
87	136
50	139

It will be seen that on an average performance extending over three successive seasons, four selections have given increased yields over the locals ranging between 32 and 55 per cent while the other four have given even greater yields varying from 111 to 139 per cent.

Another set of 23 promising selections with high yields have to be tested further. (R.S.)

COLD EXTRUSION PROCESS USED FOR BUTTER

THE Australian Dairy Production Board is experimenting with an entirely new design of butter making machine, which has been installed at the Glenormiston butter factory in south-west Victoria. If the experiments are successful, it may revolutionize the manufacture of butter.

This machine, an Australian in invention, has been manufactured by a Melbourne firm. It is unique in that it uses the extreme cold extruding process instead of churning in the manufacture of butter.

Milk is handled in the usual way until after it passes through a separator. Then the cream is piped to a special cream separator, which divides it into eighty per cent butterfat and twenty per cent butterfat skim. Butterfat is carried to a vat which standardizes it for salt and moisture content. During the process a portion of the skim is fed back into the butterfat. Then, under vacuum pressure, the butterfat enters the extruder where, in a brine solution at a temperature below zero, it is transformed into butter. The butter comes out of the machine at a temperature of 30°F.

The Glenormiston factory is one of the best in Australia. Its assets are worth £A82,000, and the shares in the company which controls it are owned by local dairymen. It uses about 35,000 gallons of milk a day, to make butter, cheese, skim milk and dried butterfat. During the past year, the factory has won six first prizes in State competitions, including the grand aggregate of points for butter factories.—*Australian Agricultural Newsletter*, No. AGN /265.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. What steps has the Government taken to make available to the cultivator adequate supplies of manure for his fields.

A. There are mainly two types of manures by the use of which crop yields in our country can be considerably increased, viz. (a) organic manures and (b) chemical fertilizers. We are at present importing about 1½ lakh tons of these chemical fertilizers from foreign countries. There is a world shortage of these and we can get no more than this quantity from outside, for the present. In our own country we are producing about 50,000 tons of artificial manure in our existing factories. All this is only a flea-bite. Much of it is priced too high for the ordinary agriculturist. The famous fertilizer factory of Sindri, yet in the making, is expected to produce 3½ lakh tons of fertilizer per year. And yet if we consider the total needs of our country we must set up in India as many as 50 such Sindri factories. We must, therefore, at the same time turn our attention to the utilization of our urban and rural organic waste materials which can be converted into organic manures so useful for increasing the fertility of our soils.

Q. In the villages the cultivators feel a shortage of fuel for cooking purposes and cow dung cakes are used for this purpose. What is he to do if he uses it in the manure pit ?

A. It is criminal to use cattle dung except for manuring. This will enable him to get increased crop production from his poor soil and he will help the Government and the country in meeting the important problem of food. The Government has been considering the cultivator's problem of fuel and have launched a campaign for planting of quick-growing trees all over the country to provide an alternate source of fuel to the cultivator for his requirements. As a result of this drive 20,51,140 quick-growing trees were planted in various provinces and States on the Independence Day observed on 15 August, 1948 and 31,750 acres have been put under forest trees to meet the need. It is hoped that the cultivators themselves would help in this direction and spare all their dung for manuring of crops.

AN AMENDMENT

Indian Farming, Vol. IX, No. 11, November, 1948 : Page 460, Col. 2. In para 2 of the answer furnished to the question appearing on this page, it was stated that 'no work has been done on the feeding of plantain leaves and trunks to animals in this country'. There is, however, a publication on this subject—Leaflet No. 1 of 1919, entitled : '*Plantain Stalks as Fodder for Cattle in Famine Years,*' issued by the Department of Agriculture, Bombay. We are thankful to Mr. W. B. Hayes of the Agricultural Institute, Allahabad, for drawing our attention to this publication—*Editor.*

DEVELOPMENT OF AGRICULTURAL MARKETING IN INDIA*

THE Royal Commission on Agriculture in India laid stress on the importance of improvement in the field of agricultural marketing. The recommendations made by the Commission were subsequently reiterated by the Indian Banking Enquiry Committee in 1931. The Marketing Committee of the United Nations Conference on Food and Agriculture held in October, 1945 at Quebec also recognized the importance marketing plays in the agricultural economy of a country. They said 'Marketing is the crux of the whole food and agricultural problems. It would be useless to increase the output of food, it would equally be futile to set up optimum standards of nutrition unless means could be found to move food from the producer to the consumer at a price which represents a fair remuneration to the producer and is within the consumer's ability to pay. Similar considerations apply to other agricultural products and to fish and forest products'.

In accordance with the recommendations of the Royal Commission, the Government of India constituted the Central Agricultural Marketing Department in 1935, now known as Directorate of Marketing and Inspection, for undertaking the necessary marketing surveys and for making a beginning on the lines broadly indicated by the Commission. With the help of contributions made by the Central Government, the Provincial Governments were enabled to set up similar marketing organizations and arrangements were made for carrying out the survey work under the technical guidance of the Agricultural Marketing Adviser to the Government of India. The cooperation of a large number of Indian States was also sought and obtained in this connection.

Survey reports

Fifty-eight survey reports, brochures, bulletins, etc. were published between 1935 and 1948. Five were published in 1948 and eight are under compilation. Most of the reports are out of stock and revision of five reports was also undertaken in 1948. It may be mentioned here that there was a setback in the progress of writing survey reports during the War period in view of the fact that the services of experienced marketing staff were utilized by the Provincial Civil Supplies Departments for the procurement and distribution of controlled commodities.

In the various survey reports so far published by the Agricultural Marketing Adviser to the Government of India, inherent flaws in the marketing systems, as are prevalent in the country, have been brought to light and various recommendations made, such as (i) grading and standardization of agricultural and livestock products, (ii) regulation of markets, (iii) standardization of weights and measures, (iv) regulation of quality of exports, (v) development of foreign trade, (vi) cooperative marketing, (vii) establishing licensed warehouses, (viii) standardization of contract terms, (ix) regulation of Agricultural Produce Exchanges, etc. Besides these, there are various other problems, such as, communication and transport, financing of agricultural marketing, storage and maintenance of market statistics and news service.

The Agricultural Produce Grading and Marking Act, 1937

This was enacted to provide for the fixation of grade standards for agricultural and livestock products and for the grant of Certificates of Authorization to private persons and corporate bodies to grade agricultural and livestock products on the basis of these standards. Under the provisions of this Act, grade specifications have been drawn up and notified for some 22 commodities and some of the commodities graded under Agmark during

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*Report of the Directorate of Marketing and Inspection up to December, 1948.

1948 alone were valued at nearly 12 crores of rupees, as under:

	Value of quantity graded (in rupees) in 1948
Ghee	3,59,50,372
Butter	34,09,811
Edible oils	93,20,382
Eggs	3,92,943
Tobacco	4,99,64,945
Sugarcane *gur*	78,849
Cotton	76,74,258
Sann hemp	1,16,23,435
Fruits	2,34,329
Potatoes	5,120
	11,86,54,444

The Agricultural Produce (Grading and Marking) Act, 1937, is a purely voluntary measure and as such there is no provision for any control on the quality of agricultural products that are exported. Complaints from the foreign consuming countries have been innumerable. With a view to enhancing the reputation of Indian agricultural produce in foreign countries, the introduction of a Bill for regulating the quality of export of any agricultural produce was taken up for consideration. In the meantime, the Central Government can prohibit under Section 19 of the Sea Customs Act the export of agricultural produce unless they are graded in accordance with Agmark standards. The Section 19 of the Sea Customs Act is now effective on tobacco and sann hemp which cannot be exported unless graded in accordance with Agmark standards. The resultant salutary effect of this has been the high reputation of Agmark tobacco, for example, in the foreign markets and a large number of tobacco growers are coming forward to form themselves into cooperatives with the object of pooling their produce and selling the same after grading in accordance with Agmark standards.

With a view to exploring the foreign markets for Indian produce, samples of a number of products (where possible graded under Agmark) were sent to the Indian Government Trade Commissioners abroad to contact the trade in their respective countries. Encouraging results have been obtained, particularly in respect of tobacco, cashew kernels, Hand-Picked Selected groundnuts, wool, etc. It was also proposed to control the quality of lac, Hand-Picked Selected groundnuts, wool and goatskins meant for export.

Regulation of markets

A model Bill on the regulation of markets was prepared and circulated in 1938 to the various provinces and States, in many of which it formed the basis for requisite legislation. Bombay, Central Provinces and Berar, Madras, East Punjab and the States of Mysore, Hyderabad, Baroda, Gwalior and Patiala have already made legislations for this purpose. Bombay has prepared a five-year plan to regulate more than half of the markets in that province. A Bill for regulation of markets in Centrally Administered Areas was prepared some time ago, but it was decided that instead of introducing a separate enactment in the Central Legislature, the Administrations in Delhi, Ajmer-Merwara and Coorg be advised to adopt one of the provincial legislations on the subject.

Standardization of weights and measures

The Central Government passed the Standards of Weights Act in 1939. Thereafter all the provinces were requested to enact suitable legislations for regulating weights and measures based on standards. Bihar, Bombay, East Punjab, Central Provinces and Berar, Orissa, Coorg and United Provinces have already enacted legislations for this purpose.

Licensed warehouses

The provinces of Central Provinces and Berar and Bombay and the Travancore State have passed suitable legislations for the establishment of licensed warehouses.

Cooperative marketing

Very little has so far been achieved in this direction and a review of the development of cooperative marketing of agricultural produce in India was undertaken with a view to suggesting further lines of development.

Standard contract terms

Standard contract terms on an all-India basis were drawn up for white wheat, linseed and groundnuts (kernels for crushing) particularly with the object of securing a suitable premium or better quality produce.

Futures trading

With a view to checking speculation, a draft Bill for regulating the operations of Agricultural Produce Exchanges was prepared. The Bill also provides for the adoption of standard contract terms for trading both in 'ready' and 'futures' markets.

Inspection of foodgrains

Fair Average Quality specifications for wheat, gram, barley, *bajra*, *jowar* and maize were drawn up for the working of the Basic Plan of the Ministry of Food and the procurement and rationing programmes of the Provincial and State Administrations. A regular inspection of foodgrains purchased by the Government of India for a Central reserve is maintained along with a supervision of such inspection of foodgrains as are moving under the Basic Plan or Rationing Scheme. Check inspections with regard to quality and weight are also carried out at convenient points. Inspection of imported grains discharged at various ports is also being attended to. (Contributed by the Directorate of Marketing and Inspection.)

JAMMU AND KASHMIR

JIA LAL RAINA

FOR some time after the partition it became difficult to obtain a supply of Diesel Oil—an insecticide for the control of San José scale, which is an important insect pest of the deciduous fruit trees in Kashmir. The trees remained untreated and were subjected to the ravages of San José scale. The export of fruits was also adversely affected; the fruits perished to the detriment of the interests of poor orchardists.

The Department of Agriculture has already taken up steps to supply the zamindars with the insecticide with the timely assistance of the Dominion of India. The Government of India has been prompt enough to arrange a supply of 40,000 gallons of Diesel Oil. There has been an increasing demand for this insecticide and many orchardists, who were loth to use it before, came forward to receive their quota.

With the help of the Indian Union arrangements are being made to ensure better marketing of the fruits produced in the State. It is proposed to introduce Cooperative Marketing System whereby the produce will be delivered direct to the consumers thus eliminating the middlemen who at present grab the bulk of the profits out of the transaction.

With the advent of the popular Government in the State, special measures have been taken to improve the lot of the man behind the plough. All the fallow land is being placed under the plough; a special Officer has been appointed for this purpose. To date 85,000 acres of land have been reclaimed and brought under cultivation by tillers to whom this land has been allotted. The yield of grain from the reclaimed lands amounted to about 1,20,000 maunds during the last harvesting season. The Department of Agriculture supplied large quantities of improved seeds for such newly cultivated lands. To bring more lands under cultivation the Government has already made available two heavy tractors. Largescale tractor cultivation is being considered for Jammu Province, and it is expected that in the near future the entire fallow land in Kathua District will be put under the plough.

About 1,500 *kanals* of land have been placed at the disposal of the Cooperative Department where a cooperative farm on an experimental basis has been laid out. At this cooperative farm the authorities are providing facilities for other subsidiary industries which would keep the farmers engaged throughout the year.

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On account of heavy rains, rivers and rivulets went into spate and inundated the lands at many places. The crops were destroyed not only by submergence but by the long spell of cold which followed. The paddy crop was greatly damaged and at many places the yield was reduced by 50 per cent.

An intensive campaign for growing more food is going on. Lands which were once utilized for growing fodder are now being cultivated for food crops. Waste lands and *numbal* (marsh land) areas are being improved and cultivated. All such lands are being leased out to tillers for extensive cultivation. The problems of supply of manure and improved implements are being (effectively tackled in consultation with Czechoslovakian experts who have been asked to submit schemes and proposals for installing a plant for the manufacture of ammonium sulphate.

The European vegetable seed growers were active throughout the season in raising seeds. Rains and the appearance of aphids in an epidemic form had however adversely affected the yield. Most of the seeds, that were finally collected, were exported to the Indian Union.

MULCHES FOR BULBS

FOUR years' results to date with mulches on tulips—the test crop—indicate they have certain specific value for conditions prevailing along the coastal area of British Columbia. Commercially, however, their value is still speculative as they have not been used extensively- Experimental data show a six per cent increase by weight in the marketable portion of the tulip bulb crop, and two per cent in the total bulb crop on the average. But it is considered that any general use of added mulch for bulbs will be governed by the availability, the cost of the material and application, as well as other important considerations such as the increased difficulty in weed control and harvesting operations. Based on these considerations and results, which also show an increase of 21 per cent in top grade of flowers in two years out of four but a decrease of one per cent on the average, it is concluded that mulches, in general, have restricted use for annual bulb crops such as tulips. Bulbs other than tulips, some lilies for example, which do not require to be lifted annually in order to obtain maximum crop increase and to control disease, may be found to benefit more fully from mulches than do tulips.

Other points revealed by these tests are that the bulb and flower crop benefited most in light and unimproved soils. Also, that there was no anticipated reduction in packing of heavy, clay type soils due to winter rains as judged by digging and harvesting operations in July. It was also revealed that mulches satisfactorily check soil erosion, a point not fully appreciated or answered as yet for large plantings where the system of culture usually demands three-foot ridged rows for machine operation and drainage.—*Department of Agriculture Information Service, Canada.*

Across the Borders

WHEAT-DOCTOR STAKMAN: FAMINE'S WORST ENEMY*

By VICTOR COHN

THE 100-year-old American Association for the Advancement of Science inaugurated as its new president in January 1949 Elvin Charles Stakman, scientist, traveller, conversationalist, teacher and friend of underfed mankind. Dr Stakman is one of America's leading specialists in plant and cereal diseases, and an assiduous student of the life and habits of the organisms that cause those diseases. Simply, this means that Stakman is one of the men who make the world's wheat grow, and who thereby insure world plenty instead of world starvation.

Gray-haired, round-faced, exuberant Dr Stakman is a professor at the University of Minnesota's agricultural college which is located in the wheat belt of the United States. At the same time, he has for 20 years been a plant pathologist of the U.S. Department of Agriculture, and an expert in discovering and eliminating wheat blight and similar crop-ruining fungi. But his work has not all been on the applied level. From his researches, he has discovered and formulated laws of breeding and specialization that help microbiologists and geneticists everywhere; and from his laws of fungus specialization drug researchers have taken many a cue in their search for new antibiotics like penicillin and streptomycin—those cousins of the unfriendly wheat rust.

Rust, a fungus, destroys $1,000,000,000 worth of wheat every year in the United States, and occasionally explodes in disastrous epidemics. In 1916, one of these rust epidemics struck. Young Elvin Stakman, then an associate professor at the University of Minnesota and an agent of the U.S. Department of Agriculture, went out to see it all for himself. He travelled from southern Minnesota westward, touring the fields by horseback and bicycle. On a number of occasions he would ride on a casually scheduled local train, and persuade the brakeman to stop the train while he dashed into a wheat field to grab a sample of the shrivelled plant.

That autumn Stakman returned to his laboratory with suitcases full of samples from all over the wheat belt of the United States. Night after night he laboured, peering through the microscope, taking notes and analyzing his results. Wheat-rust spores seen under the microscope, he found, looked alike—simple and egg-shaped. But when he sprinkled the spores over damp young Marquis variety wheat plants, some of the spores would attack and wither them, while others would find Marquis completely resistant, but would thrive on the Bluestem or Red Fife varieties.

Clearly, reasoned Stakman, there were many races of rust within each previously known variety—enough races to be able to attack any of the wheats then being grown in the United States. And just as clearly, the only way to learn all the properties of all the kinds of rust was endlessly to sample and test specimens of wheat and rust from every part of the earth. This has remained one of Stakman's main jobs for nearly two dozen years, and today some 200 races of rust are known and identified.

Out of this information, Stakman and his associates began to revolutionize hybrid wheat breeding. They started playing genetic tricks—crosses and double crosses and back crosses between fine bread wheats and tough durums.

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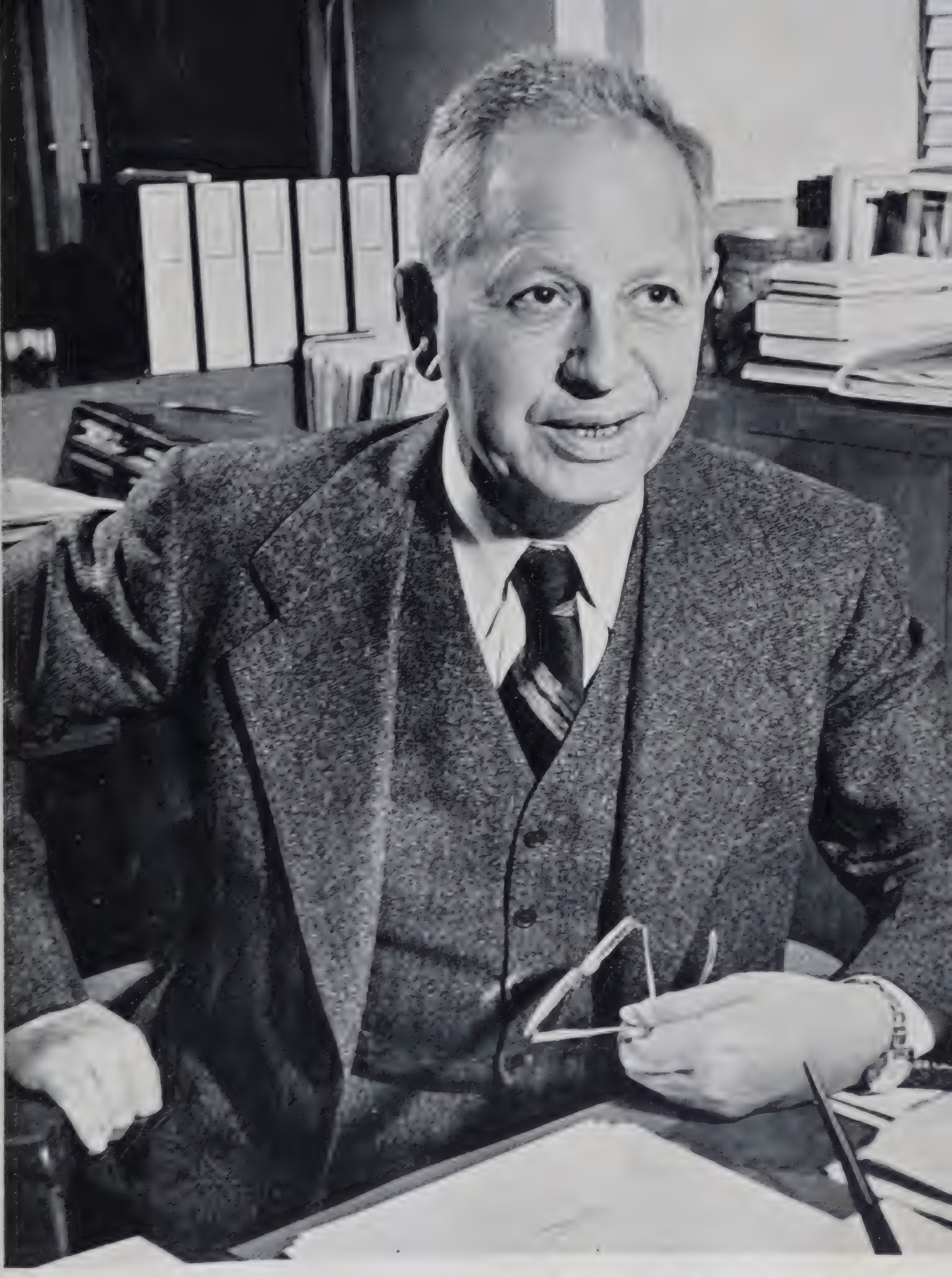
*This article appeared in the April 1949 issue of *Science Illustrated* published monthly in the United States by the McGraw-Hill Publishing Company. The writer is a frequent contributor to American periodicals. The accompanying photograph is courtesy of *Science Illustrated*.



Dr Elvin Charles Stakman, one of America's leading specialists in plant and cereal diseases, has helped double U. S. wheat output in the last 12 years by almost eliminating epidemic rust, the wheat blight.

(By courtesy of *Science Illustrated*)

They sowed their new hybrids in disease-teeming test plots and tried to kill them with rusts. The fittest and most rust-resistant survived, and became the basis of a new series of wheats, hardy and sweet.

In his study of the life-cycle of the fungi, Stakman found that rust has a dual life. In its red-coloured phase, it attacks wheat in spring and summer, pitting the stalks, drying up the sap, shrivelling the kernels. Finally it produces black spores—the second phase of its life.

These spores have to get through the winter somehow, when there is no growing wheat to thrive on. Nature's answer, formulated long ago, was the barberry bush, on which the rust can live through the cold season. From their haven on the barberry bushes, the spores return again in the spring to the wheat, once more in the red or rust-coloured phase.

Stakman declared war on the barberry bushes. 'Clean out the barberries,' he told farmers at hundreds of meetings, 'and you knock out the rust at the most vulnerable part of its cycle'. Stakman, ever a tireless conversationalist and talker, lectured away at farmers, flourmakers, legislators, nurserymen, and horticultural societies. He urged them to burn and uproot the barberries; he urged that where barberries were needed (for decoration or for their fruits), they should be replaced with the non-rusting Japanese variety.

By 1921 a group of midwestern businessmen had organized a Conference for the Prevention of Grain Rust, and Stakman became their most effective publicity man. Since 1921, members of this group have contributed more than $500,000 from their companies' treasuries to further the work.

The joint efforts of Stakman, the U.S. Department of Agriculture and private groups, have had more than a little success. Eighteen States now have official barberry-eradication programmes in operation, and the U.S.D.A itself maintains an active anti-barberry division. About 350,000,000 bushes have been destroyed, and partly as a result of this, there have been no major rust epidemics in the United States in over a decade.

But tireless Stakman learned something else early in the fight. He found that barberry eradication is not enough—for even though the last hard-to-find bush might be spotted and burned, the tiny dust-light spores still could live and perpetuate the cycle, providing they found another winter home.

This was what Stakman was afraid of. In 1921, to find out about it, he fastened vaseline-covered slides to the wings of U.S. Army airplanes, and sent the planes off to cruise around high above the States of Minnesota, Texas and Nebraska. When the planes came down, Stakman rushed to the laboratory with his precious slides, and there saw the truth. Red-rust spores had been floating around in the air, two miles up. Putting this fact together with the best available weather information, Stakman concluded that the spores, which cannot survive the winter in the United States wheat belt (except on barberries), could travel on autumn winds all the way from Canada and northern United States as far south as Texas and Mexico. There they find ample berths in the juicy winter wheat, live out their intermediate phase, and return as new red spores the next spring, to blight and ruin the wheat of the northern plains.

Today, as a result of his discoveries, Elvin Stakman lives much of his life out of a roomy, well-scuffed suitcase. Every spring he flies to Mexico to start following the spores northward on their return to the United States. With perhaps a couple of men from the University of Minnesota and a couple more from the U.S.D.A., he travels in a U.S.D.A automobile, starting each day's journey as soon as the dew is off the grain. They drive about five miles at a stretch, then stop to scatter out into the fields and gather samples.

From these trips, Stakman and his associates have learned that central North America is an uninterrupted 2,500-mile-deep rust belt, tied together by the winds. Stakman therefore has had to leap national boundaries in his fight against the disease, and together with the Rockefeller Foundation (an organization founded by the American philanthropist to foster research) he has been encouraging the development of rust-resistant wheat in both Mexico and the U.S. 'Slow down the rust in Mexico', he explains to officials of both nations, 'and you slow it down everyplace else. After a while, if you are lucky, the whole thing will just slowly have to peter out'.

It has petered out a great deal already. True, there were rust epidemics in the American Midwest as late as 1935, 1937 and 1938, and even in 1948 stem rust was still epidemic within some parts of a few States. But 1948's overall wheat harvest brought in an unusually large crop of 1,288,000,000 bushels—more than twice the production of 1935. In the light of the Marshall Plan, this was a great blessing. For that matter, wheat production in the United States was excellent all during the years of the last war.

Elvin Stakman's interest in plants started far back in his childhood, for he grew up as a typical farm boy in the mid-western State of Minnesota. He worked on the farm, herded cattle and clerked in a country store, but had no inkling that he was destined to spend his life as the friend of the farmer and the enemy of rust. Stakman even drifted into small-town teaching, after getting his degree in botany in 1906. He taught such subjects as history, political science, German and algebra, in addition to coaching basketball, football and track.

Eventually, however, he returned to the State university in 1909 and joined Dr E. M. Freeman's new plant pathology department—the first in the United States—as a graduate student and instructor. Freeman put Stakman to work on rust, and his future was settled.

In less than half a dozen years, he had become an employee of the U. S. Department of Agriculture, and by 1916 set forth on the first of his many tours of the wheat lands. The next year Stakman married a fellow biologist. While the Stakmans' married life has been a thoroughly happy one, it has never held Stakman back from his field trips, and he has spread the anti-trust gospel not only throughout the United States and Mexico, but all over Europe, Alaska and Australia.

The Rockefeller Foundation, taking note of Stakman's ability as a biologist, sent him off on various trips to survey agriculture and science in almost every country of Central and South America. The Firestone Tire and Rubber Company sent him on a trip to Liberia, Ceylon and Malaya, some years ago, to examine and check on rubber plantations.

The U.S. Government also asked him to look into the rubber situation in 1940; as part of the national defence programme, the U.S.D.A. wanted to know what the possibilities were of growing rubber in South America. He cruised up the Amazon in canoes to its headwaters in Colombia, Peru, Brazil and Bolivia, brought back seeds, budwood from wild rubber trees. His most recent trip was a flight to Japan, as a member of a team invited by General MacArthur to examine Japan's laboratories and scientific schooling.

Stakman's many trips have made him a thorough cosmopolite, and a citizen of the world. But essentially he is an earthy character, and one who gets along with farmers and plain folk as well as with college presidents and law-makers.

In addition to all his other activities, Stakman is a member of the U. S. Atomic Energy Commission's advisory committee on biology and medicine. In his own laboratories he is currently using mildly radioactive uranium salts to make fungi mutate. If the tests work out well, he will have found a safe and inexpensive way for laboratories to study genetics and mutation; it will eliminate costly machinery or dangerously radioactive isotopes.

Where Stakman gets all of his energy is a mystery. Possibly it comes merely from his love of his subject. Agriculture is more than a livelihood to him; it is the world's basic industry. 'Without plants, life would be impossible', he tells his students, 'and that makes the study of plant diseases a pretty important sort of work'. Stakman firmly rejects Malthusian pessimism—the theory that man is rapidly becoming too numerous for his resources.

Stakman has seen such great improvements in crop output as plant pathology takes hold, that he feels the earth's population 'probably could double without causing distress'. We certainly must use the new technology and the new science of plant health, he feels, or the world will starve—to this extent, the pessimists are right. But with agricultural science properly applied, the world could well feed any population the next century is apt to produce.

Yet he crosses his fingers about rust and the uncertain future. New races of rust are always appearing by mutation and hybridization; and although Stakman and his colleagues have been developing wheats that resist the known rusts, those same wheats may, unknown to him, be terribly susceptible to rusts that could develop in the future.

Stakman's life has been devoted to work which may eventually change the grim picture of hunger throughout the world. Plant pathology, he believes, can and will 'safeguard the world's food supply. Maybe we shall even be able to accomplish the greatest end of all—maybe we shall be able to remove some of the fear of want among human beings.'—*Released through U.S.I.S.*

PLANS FOR INTERNATIONAL COMMODITY CLEARING HOUSE

INTERNATIONAL commodity experts have drawn up a plan for creating a world clearing house for dealing with food surpluses. It would be designed to avert the difficulties arising from the accumulation of unsold agricultural products. The scheme has been prepared at the request of the Food and Agricultural Organization of the United Nations, and will be considered at the annual conference in November.

Recommendations contained in the experts' report have been endorsed by the Director General of the F. A. O., Mr. Norris Dodd. The main proposal is for the creation of a new world organization to be known as the International Commodity Clearing House. This body would be responsible for assisting the smooth clearance of products in agricultural markets in order to forestall the danger of surpluses accumulating. Should such surpluses occur, it would have the authority to acquire them and dispose them of to the best advantage.

This organization would, in all its activities, work through the Governments who are members of the F. A. O. or through such other channels as they might approve. Membership in this Clearing House would be open to all members of the F. A. O. and the United Nations. It is suggested that it should be set up as a public corporation with a capital of $5,000 millions.

The report divides the functions of this new world agency into seven main heads. The first and second deal with the buying of surplus stocks and commodities and with negotiations for the sale of these. The other functions are concerned with the holding of stocks acquired during periods when there is a glut, with exchange commodities on a barter basis and with the arrangement of bilateral or multi-lateral trade agreements.

The experts indicate that they do not anticipate a surplus occurring in several commodities, among which are included coffee and wool. But they do envisage that the production of sugar, cotton, certain fats and oils may exceed demand within the next twelve months. During the next three years they consider that there is an almost certain prospect of surpluses occurring. (*B.I.S.*)

A GENERAL SURVEY OF THE MILK PROBLEM IN INDIA

SARDAR DATAR SINGH

MILK is an essential universal item of Indian diets and great prominence is given to the consumption of milk, either as such or as one of its products, even by the poorest in our country. Such is the present-day demand for milk that even without any organized propaganda, there is hardly any possibility of milk remaining unutilized if it can be produced in greater quantities. Milk and milk products, apart from their nutritional and economic values, are regarded as auspicial and freely used on ceremonial occasions.

A recent survey by the Agricultural Marketing Department places the total gross production of milk in the Indian Union at 5,827 lakh maunds. Of this total, 46·7 per cent is cow milk, 50·2 per cent buffalo milk, and the rest goat milk. From this if the quantity of milk fed to the calves is deducted, the net available quantity left is 4,815 lakh maunds. The import of milk products is comparatively negligible and amounts to less than six lakh maunds per annum, estimated as fluid milk. We thus obtain an average *per capita* consumption of 5·5 oz. in terms of liquid milk per day, which you will agree is too low a consumption by our modern standards for optimum nutrition which is laid down as 16 oz. especially in a country where diets lack first class proteins and are poor in essential minerals like calcium. A majority of the population being vegetarian, the main source of animal fat is milk and milk products.

To produce the quantity of milk noted above, the country maintains 41·1 million cows, 19·6 million she-buffaloes and about 8·2 million milch goats. The average milk yield of cattle is very poor which directly raises the cost of production. The Indian dairy industry is essentially a rural industry pursued as a subsidiary to the general agriculture. Nearly 95 per cent of the stock is maintained in rural areas. The intensity of milk production varies a great deal. It is the highest in places like Delhi, Baroda and East Punjab, and lowest in Mysore, West Bengal and Assam. The average quantity of milk produced per square mile, per day, for the country as a whole comes to only 83 lb. The maximum production per village comes to hardly a thousand pounds per day in Delhi Province, where the production is the highest. This will in some measure explain why it is so difficult to organize our dairy industry on the Western pattern.

Another important point is also worth noting here. The production of milk is lagging behind the increase in human population and unless strenuous efforts are made to remedy this, the position is likely to become serious with the passage of time. The low yield of our cattle is essentially due to two factors: (1) lack of proven sires, and (2) lack of right type of feed.

As regards the production of milk, the output varies widely from province to province. Assam produces less than 1 per cent of the total milk, while the United Provinces produce nearly 23 per cent. Bihar, East Punjab, Madras and the United Provinces together contribute nearly 57 per cent of the total cow and buffalo milk produced in the country. For the country as a whole there is a need for nearly three and a half fold increase in milk production to meet

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the optimum nutritional requirements of our population. Those who have studied the problem will soon realize that with the resources at our disposal it is not easy to reach the target in the very near future. As a less ambitious, but more practicable project, the Government of India have a plan to increase the total milk production by about 10 per cent in five years. This increase will serve to meet the minimum nutritional quantum of 1 lb. per head per day only of the most vulnerable group in our total population. To achieve this, each province will be expected to increase its quota by 10 to 15 per cent over the present level of production.

Coming to the utilization of milk, due to our peculiar circumstances, only about 36·2 per cent of the net available milk is used for fluid consumption, and the rest utilized in the form of its products. The most important of these products is *ghee*, for which nearly 43·3 per cent of the available quantity, amounting to 2,085 lakh maunds is used annually, while curd, *khoa* and table butter account for the remaining 19·5 per cent. Realizing the acute shortage of fluid milk, one possibility of increasing the supply would be to decrease the quantity utilized for *ghee* making. Considering the present market price of *ghee*, it has become a rich man's food, not to mention the doubts cast on its quality from time to time. By increasing the supply of fluid milk, the distribution can be made more even. A cheap and efficient method for preserving and transporting milk is the crying need of the rural dairy industry.

At present the price paid by the consumers for milk in the urban areas is probably the highest in the world in spite of the fact that the milk is sold loose without any processing. Since the war, the prices have increased by 200 to 300 per cent in different localities which tends to make the distribution of available quantities all the more uneven. The high price of milk in the urban centres has been repeatedly discussed and it is largely due to the abnormal cost of housing and feeding the cattle in the urban areas. At present it is estimated that nearly 441 lakh maunds of fluid milk is consumed in the urban areas and probably an equal quantity in the form of various products, thus accounting for nearly 19 per cent of the total milk production. The complexity of urban milk problem will be evident from the fact that besides two lakh urban producers, about five lakh persons are engaged in the assembly and distribution of milk. The problem can be simplified by organizing the production on scientific lines.

About the quality of market milk, the less said the better. Fortunately due to the universal practice of boiling milk, the incidence of any disease being transmitted by milk on a wide scale is remote. While the spread of diseases through the consumption of milk thus seems to be remote, the same cannot be said of products like butter, *khoa*, ice-cream, etc. which are sold in the market too often in not a very hygienic condition and some vigilance on the part of the health authorities seems necessary. About the composition of market milk, there is no doubt that adulteration is practised on a liberal scale and it is difficult to keep a check when there are so many agencies producing and handling small quantities of milk.

This in brief is a general picture of the present-day milk problem. This picture is not too bright, but milk is such an important commodity, from whatever angle one cares to look at it, that something must be done early before the situation gets out of hand. If we all strive with one purpose leaving aside for the time being our individual fads and dogmas, the problem should not prove insurmountable. It is a task which grows bigger by postponing and the earlier we start the better. (Reproduced from *Indian Dairyman*, August 1949).

Book Reviews

VERNALIZATION AND PHOTOPERIODISM: A SYMPOSIUM

By A. E. Murneek and R. O. Whyte (Published by Chronica Botanica Co., Waltham, Mass., U.S.A., 1948, pp. VIII+196).

THIS symposium takes stock of the present position regarding our knowledge of the physiology of flowering in higher plants. Sixteen authors have contributed to it and have presented balanced reviews of researches on different aspects of the problem. An attractive feature of the book is excellent photographs of several leading plant physiologists who have made distinctive contributions in this field. The wealth of information contained in this book can be judged by the titles of chapters: History of Research in Vernalization by R. O. Whyte; History of Research in Photoperiodism by A. E. Murneek; Hormones in Relation to Vernalization and Photoperiodism by K. C. Hamner; Wave Length Dependence and the Nature of Photoperiodism by H. A. Borthwick *et al*; The Photoperiodicity of Flowering under Short Day with Supplemental Light of Different Wave Lengths by G. L. Funke; Nutrition and Metabolism as Related to Photoperiodism by A. E. Murneek; Anatomical and Histological Changes in Relation to Vernalization and Photoperiodism by R. H. Roberts and B. E. Struckmeyer; Length of Day in the Climates of Past Geological Eras and its Possible Effects on Changes in Plant Life by H. A. Allard; Vernalization and Photoperiodism in the Tropics by S. M. Sarkar; Some Preliminary Observations of Phenological Data as a Tool in the Study of Photoperiodic and Thermal Requirements of Various Plant Material by M. Y. Nuttonson; and Thermoperiodicity by F. W. Went. There are also three supplementary chapters in German: Studies on Photoperiodicity in the Tropics by E. Bünning; The Developmental Physiological Meaning of the Endogenous Daily Rhythm in Plants by E. Bünning; and Contributions to Genetics of Photoperiodism by A. Lang.

It is impossible to state briefly within the limited space of a review the present position regarding our knowledge of the physiology of flowering. It appears that all contributors subscribe to the view, originally advanced by Sachs, that some special substance or substances direct the processes that lead to the initiation of flowering, although these have defied isolation so far. It would appear that research has now progressed almost up to the limit of biological analysis of the problem and striking advances may not be expected until these substances have been identified.

The position as regards the application of these researches is, however, more fortunate. It does not appear probably that the method of vernalization will have a wide application except perhaps in those tracts where conditions of drought or flood offer advantage to a crop maturing earlier by a few days. In other tracts it would seem more profitable to use superior genotypes, if available. Low temperature treatment would, of course, be useful in genetical or similar research. From agronomic point of view the vernalization (natural) of developing embryos while still attached to the mother plant should be considered in the selection of areas for seed production and in plant introduction and the moving of seeds from one environment to another. Early strains may become late and vice versa. Devernalization as a result of a temporary period of high temperature or water-logging may also affect a number of agronomic questions.

Another application of this research is well-illustrated by the success achieved by the well-known bulb industry of Holland in preparing bulbs (by suitable temperature treatments) capable of timely flowering by Christmas, in extending the succession of blooms for the market and in conditioning bulbs for export from the northern hemisphere to the southern hemisphere so that they are at once adapted to the changed season from autumn to spring. Those keen on understanding the scientific principles underlying these applications will find valuable information in this book.

The reviewer has but one comment to offer. In view of the important contributions of the Russian workers to this subject this excellent monograph would have gained in completeness had at least one representative worker from the Russian school contributed to it. Perhaps this was not possible due to the Iron Curtain which unfortunately separates at present the U.S.S.R. from the rest of the world.

The book includes a subject and an author index and the get-up is in keeping with the usual high standard of Chronica Botanica Company. (R. D. A.)

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MANUAL OF GENERAL SILVICULTURE FOR INDIA

By H. G. Champion and A. L. Griffith (Oxford University Press, 1945, pp. 1-XV+1-329 with 2 maps, 5 diagrams and 28 plates, Rs. 25).

THIS publication appeared originally in 1938 and is known intimately to forest officers trained at Dehra Dun. It is perhaps not suitable for light reading by the non-forest man, but forestry the world over is now news for the layman as well and with the help of the index, this publication will serve to throw light on any general forestry matter in which one may become interested, in our country.

To the serious student, a word of caution must be uttered and that is that silviculture cannot be learnt from books. The forest is the real text book for silviculture and a season's original observation is superior to the study of tomes on the subject. But these tomes have their uses, because they record what others have observed and it is only by sharing their experience in a practical way that a real insight into the subject can be obtained. Some of the postulates may turn out to be perverse when tested out in the field. At the same time forest crops take long to mature and no one individual can have the monopoly of observational facts in relation to them and dependence on literature for many of the fundamental facts is inescapable for specialization.

To the land owner who wishes to go in for planting for fuel or small timber Chapter VI on artificial regeneration will give an enlightened background to matters germane to the work; also Chapter VII dealing with afforestation.

Chapter I is concerned with the locality factors of the forest, detailing the climatic and edaphic factors for forest growth, and methods adopted for maintaining the productive capacity of the site.

Chapter II deals with the growth form of trees and crops, flowering and seeding, germination of seed and establishment of the plants, growth, vegetative reproduction and inheritance of parental characters.

Chapter III deals with water, light and food relations, movements and excretions under tree and crop physiology.

Chapter IV tells us about pure and mixed crops, competitions among species, colonization and succession and forest types.

Natural regeneration is dealt with in Chapter V and tending including thinning in Chapter VIII.

Information has been used mainly from Indian sources, though in the sections on tree physiology and soil, foreign experience has had to be accepted, due to the lack of suitable Indian data. The authors have, however, not brought into the limelight the crying needs of the second phase of artificial regeneration in India relating to forest pathology, on an ecological basis and the role of trace elements, which marks the era where silviculture gets to grips with its life strings to emerge as a triumphant science for the good of any country. (J.P.)

News and Views

CENTRAL POTATO RESEARCH INSTITUTE

THE Central Potato Research Institute set up a few months back by the Ministry of Agriculture, Government of India, started functioning at Patna, its permanent location. The Institute which is believed to be the first of its kind in the East, will coordinate researh so far undertaken in various sub-stations of the Indian Council of Agricultural Research at Simla, Bhowali and Kufri and will chalk out a scheme for fundamental research on the production and utilization of the potato crop.

Potato as a nutritive food is an important item of diet. Apart from its energy value, it contains appreciable quantities of portein, minerals and vitamins B and C. In India, although the soil is suitable in most areas for potato cultivation, only about 0·2 per cent of the total crop area is under potato and the annual production is about 1,800,000 tons. Leaving aside the quantity required for seed purposes, about 8 lb. of potato are available annually per head as against about 500 lb. per head per annum in some of the Western countries.

The main obstacles in the way of increased production of potato in India are (1) absence of different varieties of potato suited to varying conditions of climate and soil in different parts of the country ; (2) non-availability of sound, healthy seed in adequate quantities, at the right time and at a reasonable price and (3) the heavy toll taken by fungal, bacterial and virus diseases and insect pests. The Institute will undertake research into these problems. (*P.I.B.*)

SURPLUS WHEAT FROM THE U.S.A.

A NEWS agency reports that British grain experts are interested in Pandit Nehru's remark in New York that India would like some of America's surplus wheat for a stockpile to keep down prices in India. For several months some well-informed quarters have canvassed the possibility of India obtaining a bulk supply of U. S. grain without immediate payment. The United States can spare it with the greatest ease and indeed to its own advantage, since it has a real surplus.

In India the bulk supply would be invaluable to combat inflation. Even if none of it were ever sold, it would overhang the market and help keep down prices of Indian grain by frightening hoarders into sending their hoards to market. Supplies of foodgrain in the United States this season are the biggest on record, and wheat supplies are very big. Supply of maize, a record last season, is still bigger this season by the huge amount of 10 million tons. When more of the maize is harvested, the United States will probably have to store some grain in Canada.—*Food Bulletin*, October 24, 1949.

DEFEATING THE TSETSE FLY

UNDER a scheme sponsored in 1944 by the Imperial Chemical Industries, the late Dr F. H. S. Curd and Dr D. G. Davey discovered a new drug—Antrycide*—specific against nagana in cattle. The discovery will go a long way to protect cattle from the tsetse fly pest. The drug was perfected in the laboratories at Manchester and has been found to be a curative of all forms of trypanosomiasis. Now, it has been made a subject of field tests, under natural conditions in the fly-infested areas of Africa, to ascertain its prophylactic properties. The work, at present, is being conducted along two channels, firstly, to ascertain the length of time cattle can be kept healthy in tsetse-infested areas with a single dose of Antrycide and secondly, to establish the amount of drug needed as a standard field dose. As a long term issue, it is also to be ascertained whether or not cattle can be kept healthy indefinitely in tsetse areas and whether cattle born there develop any degree of natural immunity to the disease.

Results available so far indicate that the effect of the first administration of the drug lasts for a few months only, and if re-treated within first four to seven months, immunity for at least a year is assured. In Kenya when animals protected with Antrycide were moved into the tsetse area, no signs of trypanosomiasis were seen in their blood stream, and these, on the other hand, showed definite improvement in general condition.—Adapted from Press Note No. FA/170 issued by *B.I.S.*

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*It is proposed to conduct trials in Indian cattle with this drug at the Indian Veterinary Research Institute, Izatnagar.

AN AMENDMENT

WITH the article entitled : '*The Sugarcane Crop in the Vizagapatam District and its Weather Requirements*' by Shri A. Sankaram, appearing in the January 1948 issue of *Indian Farming*, the designation of the writer has been wrongly printed as Superintendent, Agricultural Station, Anakapalli. The writer is a Research Scholar at the Indian Agricultural Research Institute, New Delhi.—*Editor.*

NEW BOOKS RECEIVED

1. *Achievements of the Indian Central Sugarcane Committee and its Future Needs* by Datar Singh (Published by the Indian Central Sugarcane Committee, New Delhi, pp. 14, price not mentioned).

2. *British Farm Mechanization*, Vol. 1, No. 1, April 1949. Edited by H. M. Hughes (Published by Temple Press Limited, Bowling Green Lane, London, E.C. 1, pp. 46, price 2s.).

3. *Journal of the Zoological Society of India* Vol. 1, No. 1 (Published by the Zoological Society of India, Calcutta, 1949, pp. 1-70). The get-up is satisfactory but a little better cover would have added considerably to its general attractiveness. (H.K.L.)

COVER ILLUSTRATION

A Central Himalayan View from Ranikhet.

(Sketch by N. S. Bisht.)

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The Hon'ble Pandit Jawaharlal Nehru is seen with Mrs. Indira Gandhi, Her Excellency Vijaya Lakshmi, Indian Ambassador to the U.S.A. looking at cows inside a dairy at the Glenn Peterson farm near Chicago which they visited on 28 October, 1949, during the Prime Minister's visit to the city.—*P.I.B.*

PLATE 71

INDIAN FARMING

DECEMBER, 1949

Vol. X No. 12

SELF-SUFFICIENCY IN COTTON*

I HAVE great pleasure in welcoming you to this, the sixtieth meeting of the Indian Central Cotton Committee.

Before touching upon the items of interest on the agenda, I should like to refer to the changes in the membership of our Committee by retirement or resignation since we last met. Shri Neville Wadia, Pandit Thakurdas Bhargava, Shri Bhawanji A. Khimji and Shri T. P. Barat have been appointed as additional members. Shri R. G. Saraiya, our Vice-President, has now been nominated to represent Cooperative Banking on the Committee. Seth Narayan Das Mukherjee and Seth Bhogilal M. Shah have been appointed to represent the United State of Vindhya Pradesh and the United State of Kathiawar (Saurashtra) respectively. Mr. J. M. Heeramaneck has been appointed as the representative of the Upper India Chamber of Commerce. I am glad to say that Shri K. Sen, Joint Secretary to the Government of India, Ministry of Industry and Supply, who is present at this meeting as an invitee, has now been appointed by the Central Government as an additional member on the Committee. I should like to extend a hearty welcome to all the new members. I am sure that the Committee will benefit by their contribution to the consideration of the various subjects on the agenda. We are also glad to have with us today Dr P. S. Deshmukh, Chairman, and Messrs. Siddaveerappa and Chaudhri Ranbir Singh, Members of the Cotton Marketing Committee recently set up by the Government of India.

Major S. R. Pocock, who formerly represented the Upper India Chamber of Commerce, has resigned his membership on the Committee as he has retired from business in India. He has requested me to convey his regret in taking leave of the Committee and his best wishes for the furtherance of the excellent work which the Committee has performed in the past. I am sure you will like me to inform him in reply that the Committee, while regretting his retirement from India, appreciates greatly the work he did as its member, and that we will very much miss his genial presence at its meetings.

You are probably aware that in April last our Vice-President was sent by the Government of India to Brussels as leader of the Indian Delegation to the eighth session of the International Cotton Advisory Committee. Two important resolutions were passed by that Committee, pertaining to (1) the publication of the monthly reviews of the world cotton situation and (2) a special study of developing world cotton situation with a view to suggesting ways and means for increasing the consumption of cotton and bringing about an adequate balance between production and consumption. These resolutions were referred to our Committee for opinion by the Government of India in June last. The resolutions and the reply sent to the Government of India by the Secretary in consultation with the members of the Local Sub-Committee are included in the agenda of this meeting for your consideration.

As regards the statistical position of cotton in India, the annual consumption of cotton by the Indian mills is about 42 lakh bales whereas our annual production after the partition of the country has varied from 23 to 32 lakh bales. The difference between consumption and local production has been met partly by dipping into the stocks on hand and partly by imports from Pakistan and other foreign countries. This Committee feels it necessary to make India self-sufficient in respect of her cotton requirements and has deliberated on this subject on several occasions during the past two years. This important question is again to be taken up for discussion at this meeting.

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* Presidential speech by Sardar Datar Singh at the sixtieth meeting of the Indian Central Cotton Committee.

It will be recalled that at its meeting held in March, 1948, the Committee recommended to the Government of India that steps should be taken to increase the area under medium and long staple varieties by 4·0 million acres but this recommendation could not be given effect to by the Government of India owing to the repercussions such increase of area may have on the food position. Recently, on a reference from the Government of India, the Secretary of the Committee prepared and sent them a plan for increasing the production of cotton of the varieties imported from Pakistan by 1·55 lakh bales during the next two years. The plan envisages replacement of short staple cotton by long staple American types on 3·12 lakh acres and the application of ammonium sulphate to 3·75 lakh acres of irrigated cotton. The Directors of Agriculture of the various provinces have considered this subject and the views of the Agricultural Research Sub-Committee on their recommendations are before you. I may mention that some progress has already been made in increasing the production of Buri and Cambodia cottons in Madhya Bharat and the Central Provinces and Berar, L.S.S. in the East Punjab, Parbhani American in Hyderabad State and Cambodia 4 B.40 in Madras Province, as a result of the seed distribution schemes subsidized by the Committee. Steps are also under way to extend the cultivation of P.A.216F in the East Punjab and the Patiala and East Punjab States' Union, Jayadhar and Laxmi in Bombay Province, Gaorani 12 in Hyderabad State and H.420 in the Central Provinces and Berar. A proposal for the replacement of Jarila by the new variety 197-3 in Khandesh is under consideration. The possibility of growing perennial cottons of the types which could replace Pakistan cotton like L.S.S. is also receiving attention. The chances of increasing cotton production in some of the new States' Unions are also being explored. However, a good deal more remains to be done before our indigenous cotton supplies can be said to have been augmented appreciably and until then we will have to continue importing long staple cotton in large quantities from other countries. In this connection, you will consider several seed distribution schemes at this session. I am also glad to report that I have been able to arrange for the release of some 15,000 tons of ammonium sulphate for use on the cotton crop of 1950-51, mostly in irrigated areas. With the decision of the Pakistan Government not to devalue the Pakistan rupee, the need for redoubling our efforts to produce in greater quantities the varieties of cotton we have been importing from that country and thus attain self-sufficiency in the shortest time possible has become still more imperative. An increase in the production of short staple cotton for export to hard currency areas for the purpose of adjusting the balance of payments also needs consideration.

At the last meeting, the Committee resolved to recommend to the Government of India to raise the floor and ceiling prices of cotton and also the differentials fixed for medium and long staple varieties. The need for announcing the prices sufficiently in advance of the sowing season was also stressed. As members are aware, the Government of India announced the floor and ceiling prices of cotton for the 1949-50 crop some time in May last, before the sowing season. The price differentials for medium and long staple cottons for the current season have been substantially raised. It is hoped that the new level of prices will act as an effective incentive to increased cultivation of superior varieties of cotton.

Last year, some difficulty was experienced by the Agricultural Departments in securing the required supplies of pure seed of improved varieties. The prices obtainable for *kapas* in the open market were much higher than the parity prices payable on the basis of the controlled ceiling prices of ginned cotton. Therefore, the growers of improved varieties refused to market their cotton through the Agricultural Departments. Similarly, as a result of the restrictions imposed by some provinces and States on the export of cotton from their territories and because of relatively short crop, textile mills in many parts of the country found it difficult to meet their requirements of cotton. At its last meeting the Committee passed a resolution requesting the Government of India to persuade the provinces and States concerned to remove the restrictions. As a result of the action taken by the Central Government, the ban has been partially lifted. The Government of India have also amended the Essential Supplies (Temporary Powers) Act, 1946, making *inter alia* cotton and cotton seed centrally reserved subjects in order to ensure uniformity of licensing and control in the provinces and States.

You will be glad to know that legislation for the prevention of mixing of different varieties of cotton and other malpractices has been passed by the United Provinces and Madras Governments, while steps are being taken to enforce the legislation for this purpose already enacted in the Central Provinces and Berar. It is hoped that before long, similar legislation will be passed and enforced in the remaining major cotton-growing provinces and States' Unions, where it has not already been enacted.

I may also refer to the ordinance entitled 'The East Punjab Improved Seeds and Seedlings Ordinance, 1949', promulgated in the East Punjab. The provisions of the ordinance are proposed to be availed of for enforcing the compulsory cultivation of approved varieties of cotton in specified areas. It is also understood that a Cotton Control Bill is under the active consideration of Madras Government. In the Central Provinces and Berar, Buldana district has been declared a separate protected area for Jarila.

As decided by the Committee at its last meeting, the question of the future set-up of the Institute of Plant Industry, Indore, has received close attention. You will see from the papers before you that certain tentative conclusions have been reached as a result of the deliberations at the meetings of the Special Committee convened by me as Vice-Chairman of the Board of Governors of the Institute. The changes required to be made in the Memorandum of Association and Rules and Regulations of the Institute, in the light of the conclusion reached by the Special Committee, have been referred to the Ministry of Law for advice and I hope to get the matter expedited on my return to Delhi. Meanwhile, certain administrative steps have had to be taken for the proper working of the Institute. I hope they will receive your approval.

An important subject on the agenda on the financial side, is the proposed request to the Government of India for an additional lump sum grant from the Cotton Fund of Rs. 40 lakhs. The reasons for the request are explained in the Secretary's note on the subject. I would like to have your considered views in this connection.

Before I conclude, I would like to make special mention of the tours which the Secretary of the Committee has been undertaking from time to time in connection with the question of increasing the production of cotton. His tour reports will show you the suggestions he has made on this subject. The action taken by the authorities concerned on the recommendations made in his previous tour notes is also indicated in the papers before you.

Original Articles

THE RED HAIRY CATERPILLAR AND ITS CONTROL*

AMONG the insect pests of economic importance some hairy caterpillars belonging to the family Arctadea are sometimes very serious. *Amsacta moorei* Butler and *Amsacta albistriga* commonly known as *kutra, kamilla, bhangu kutta* or *kantra* in the Punjab, *katro* in Gujerat, etc. are very serious and are often responsible for considerable damage to young *kharif* crops particularly pulses and other legumes. It is distributed throughout India. The cultivator is generally familiar with the caterpillar stage of this insect as it is only in this stage that the pest does the damage, eating away all the leafy portion of the infested crop. Damage to young seedlings of sunn hemp, cotton, *jowar* (*Andropogon sorghum*), maize, *til* (*Sesamum indicum*), *arhar* (*Cajanus cajan*), *guar* (*Cyamoposis psoraliodes*), *mung* (*Phaseolus radiatus*), *urd* (*P. mungo*), *moth* (P. *aconitifolius*), etc. is appalling, so much so that in many cases the crop has to be re-sown. The caterpillars always actively move in swarms among the seedlings from field to field crossing the roads and foot paths and dry irrigation channels, etc. When touched, they curl up, fall off the plant and feign death. After a few seconds they uncurl and swiftly run away to escape capture.

Life history and habits

The moths start appearing with the first shower of the monsoon which is generally received in the month of June varying from province to province. The appearance of the Red Hairy Caterpillar is, therefore, simultaneous with the sowing of *kharif* crops. The period of emergence of moths extends over a period of about a month but the active period is only for first two or three weeks.

The moth (Fig. 5) has whitish wings which have several black specks. The outer margin of the forewings is scarlet, orange or red with a series of dark spots arranged in two rows. The male moth is smaller than the female. The moths avoid sun light. During the day they are found hidden under fallen leaves, twigs, and even clods of earth in the fields. Both sexes of moth are strongly attracted, in different degrees, to light.

Immediately after emergence moths start egg-laying. A single female lays as many as 1,600 eggs in batches of 50 to 800 (Fig. 1). Eggs are generally laid on the upper surface of leaves of any cultivated or wild vegetation. Eggs appear more or less like poppy seeds sticking to the surface of leaves. They are yellow in colour and are very conspicuous against the green surface of leaves and can be easily detected even from a distance. The colour of the eggs soon changes into deep-yellow. After three or four days yellowish-grey caterpillars, about 1·5 mm. long, hatch out of the eggs and remain clustered round the egg-shells before they move out in search of food. From this period onward, fresh hatchings of caterpillars appear almost every day for about a month and crops suffer very heavily from these caterpillars eating the young seedlings. It will be observed that hatching of young caterpillars simultaneously with the germination of the crops is a point of great economic importance.

Feeding habits

To begin with the caterpillars feed in small patches on lower surface of the leaves. When they are nearly half-grown they are capable of completely devouring leafy portions (Fig. 3). As they grow further, they are capable of

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*By the Plant Protection Adviser to the Government of India, New Delhi.

Red Hairy Caterpillar (*Amsacta moorei* Butler)

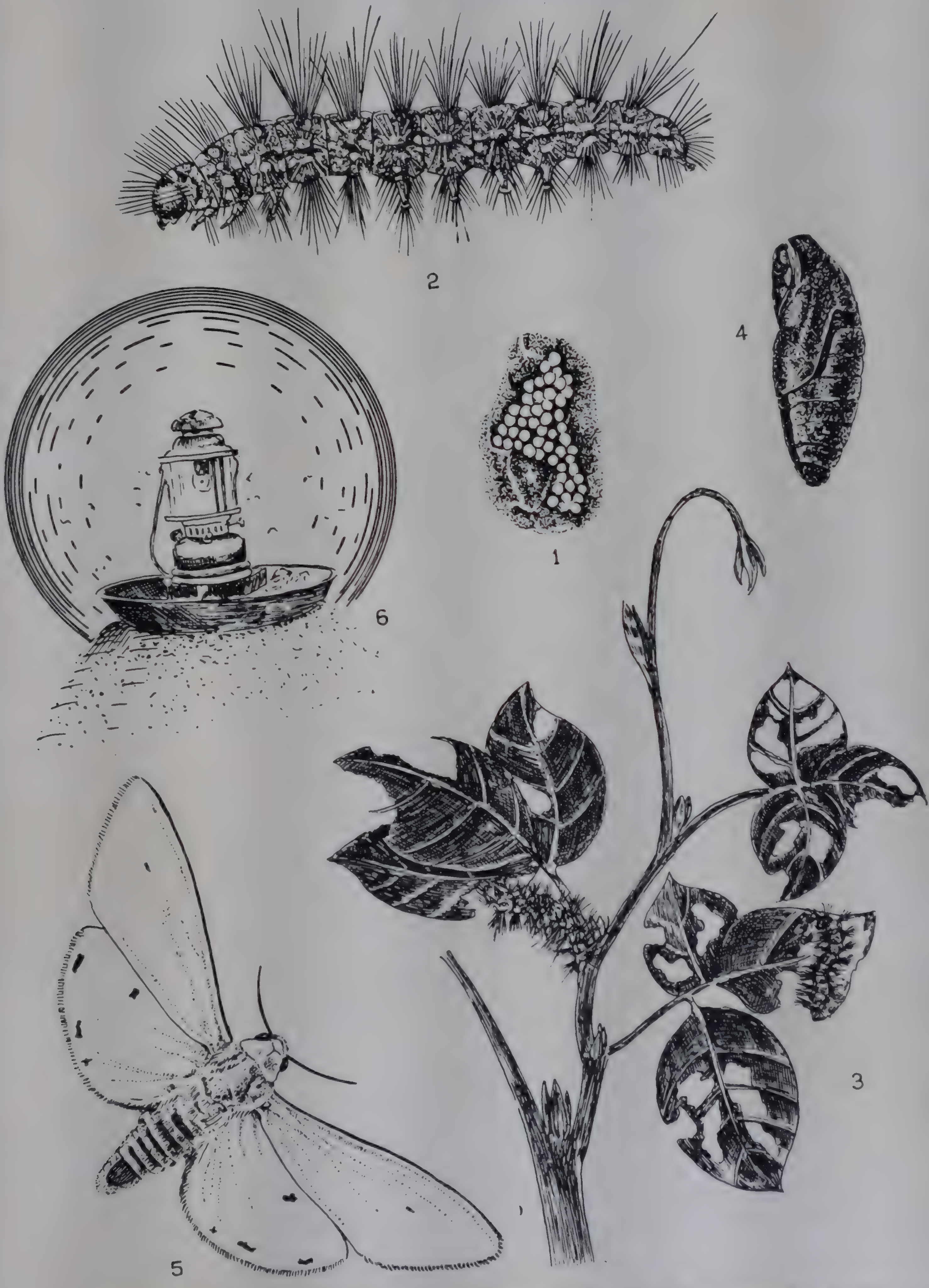

FIG. 1. Eggs. FIG. 2. Caterpillar. FIG. 3. Caterpillar feeding on leaves. FIG. 4. Pupa. FIG. 5. Moth. FIG. 6. Light trap.

voraciously eating the entire seedling. It is on account of this fact that freshly germinated crop form the first meal for caterpillars especially the growing point of the plant. Therefore, if a few plants here and there happen to escape, they cannot grow further as their growing points have been eaten away, thus resulting in a complete failure of crop.

The caterpillars (Fig. 2) can be easily recognized by their conspicuous colour and their bodies having tufts of long and short hairs arising from fleshy tubercles arranged in transverse rows. The colour of these caterpillars varies from reddish umber to olive-green. Some of these caterpillars are ivory black, others have the front and the hinder parts of their bodies black and the rest olive-green. The full-grown caterpillar measures about an inch and a half in length. It is rather unfortunate that caterpillars in their younger stages are not easily detected, because their colour blends with the colour of the leaves and also because they superficially feed on the lower surface of leaves. By the time the cultivator discovers the presence of these caterpillars, the damage already done is considerable. The caterpillars remain feeding for 20 to 30 days after which they start going under the soil, shed their hair and spin cocoons within which they rest and become pupae.

The pupa (Fig. 4) is elongate, oval in shape, brownish-green in colour and covered over with olive-green hairs. The pupa remains underground and generally lasts for 7 to 12 days, sometimes even three months and over. During June and July only, a generation is completed within about a month, whereas in August and September it may take about five weeks. In some parts of India there is only one generation a year. The pupae formed in July and August sometime remain under the soil up till the next rainy season when they emerge as moths. Two overlapping generations and sometimes even three have been observed, but the vast majority of the moth always appears at the outbreak of monsoon of the following year. It will, however, be observed that the pest appears in the field with the sowing of *kharif* crop and remains active up to almost the harvesting time. It then disappears and remains under the soil in the pupal stage till the next monsoon season.

Control measures

Successful control of the Red Hairy Caterpillar can be achieved by organizing an efficient and timely campaign on cooperative basis and over a wide area. Every cultivator should be made familiar with and made to understand how to take advantage of its habits such as appearance of the moth after the first heavy rain shower, attraction to light, mode of laying eggs in batches, movement in large swarms and mode of feeding and methods of pupation.

Moths: In the control of moths, light-traps (Fig. 6) consisting of some strong light such as lanterns, gas lamp, etc. placed in the middle of shallow vats containing water with a thin layer of oil on top should be set up immediately on the night following the first heavy shower of monsoon rain. Only two or three light traps in selected areas should be set up to serve as indicators. As soon as the moths start emerging, light-traps should be set up in the entire area and continued during the period of emergence which lasts for about a month. It may be of great advantage to organize survey of the pupating places so that the light-traps could be set up along or near about such situations. The traps should be placed on mounds of earth about four feet high (or any other suitable contrivance high enough) so that the light may be visible and the moths attracted from a distance. It is necessary that arrangements such as provision of lights, kerosene oil, vats, water, etc. are also made well before the break of the monsoon. One gas lamp of about 200 candle power can serve to attract moths within an area of about 15 acres, whereas an ordinary lantern of 15 to 20 candle power will be able to attract moths within an area of about a couple of acres.

Moths are attracted in larger numbers on warm, quiet and moonless nights. Although on cool and moonlit nights the attraction of moths to light is low but these factors are of little importance during the period of heavy emergence. It will, therefore, be advisable that the light-traps should be continued during the entire period of emergence. To ensure complete control lights attracting moths should be supplemented by other measures as well. A good number of moths generally escape from the traps. Having escaped the trap, they are generally found sluggishly resting close to the traps within a radius of about a foot or so. As they are sluggish they can be picked up by hand and killed in kerosene water in the vat. It is, therefore, necessary that a small gang of labourers should be organized who should go round to do the necessary hand-picking of moths.

Eggs : Eggs which are generally conspicuous on the leaves should also be searched over the infested area in situations pointed out before, and killed by putting them in kerosenized water.

Caterpillars : Collection and destruction of caterpillars should be organized over a large area. They may be collected by the following methods :

1. By picking them by hand and killing them in kerosenized water. Since the hairs of the caterpillar irritate the human skin, it will be necessary to protect the hands while picking. Sometimes collection of caterpillars with a big sweeping net is also practicable.
2. By digging trenches, about 8 in. deep and 10 in. wide between fields, isolating the infested from the uninfested ones. The trenches should be filled with weeds to which caterpillars are attracted for feeding. They can then be swept together and killed. Instead of filling trenches with weeds, sometimes small pits are dug in the trenches at short intervals. The caterpillars passing the trenches fall into these pits and can then be killed. Trenching has not been found satisfactory, as caterpillars sometime crawl up the sides of the trenches even when the sides towards the uninfested area are kept perpendicular and covered with loose soil.

If all ,the methods pointed out above are carried out properly in the order described, the use of the insecticidal method of control will be greatly obviated. Taking into consideration the risks involved in the use of poisons and the present standard of education of the average cultivator, spraying, dusting or baiting with poisonous chemicals, though effective if properly carried out, cannot be safely recommended. Spraying the infested vegetation with 0·1 per cent to 0·2 per cent DDT and dusting 50 per cent BHC solution will effectively kill the caterpillars.

Pupae : Deep ploughing, after the *kharif* crops have been harvested, of the infested area and thus exposing pupae lying in the soil is also useful. The pupae thus exposed get crushed or fall prey to birds like *myna* and black crows.

SOIL CONSERVATION*

By A. T. SEN

IN India, soil conservation has not received the attention it deserves; in fact in many quarters the subject is not even fully understood. Thus to some, soil conservation is merely a control of erosion. It is not that only, it is something more. It means control of erosion, prevention of the impoverishment of the soil, making the best use of the available water, drainage where necessary; in fact 'whatever else needs to be done to keep the soil permanently productive or make it more productive'.

Soil conservation, to define it briefly, is a matter of putting the land to its appropriate use and then to subject it to maximum exploitation consistent with its safety with supporting practices. It, therefore, calls for the determination of the appropriate use to which a particular land is best suited and of the practices which will enable the maximum and safe exploitation of the land in that use. It is possible with our present scientific knowledge to say with a fair degree of accuracy the appropriate use to which the particular land should be put to, but the practices, enabling the maximum safe exploitation of the land in that use, are still a matter of experimentation and research particularly in India. However, an appraisal of our present knowledge on the subject both in India and elsewhere, is desirable.

It must also be mentioned that although it is possible to find out the appropriate use of the land from scientific consideration, the adoption of that use by our farmers is beset with difficulties. The present land uses in India are the results of cumulative influences of economic and social factors. It will not be wise to ignore the fact. In a conservation programme, therefore, due recognition should be given to the fact, and the object must be achieved through education rather than through enforcement. The progress will necessarily be slow; but it is better to face facts in their correct perspective, from the very beginning, in order that we may be able to fill up the gap, in an appropriate manner, between our existing efforts in securing information and what is needed for applying soil conservation measures on the field.

Finally, there is a need for drawing up a national programme of soil conservation in which the activities of governmental agencies and of farmers are to be integrated and coordinated.

It is the purpose of this paper to deal with each of the above-mentioned points very briefly with the objective in view, viz. increased agricultural production and the conservation of the most important of our natural resources, the soil.

Appropriate land use

To evolve a system of determining appropriate land use, a new concept of classifying land according to its use capability has been introduced. In this system all the important factors which limit maximum production of land are taken into consideration. The factors considered are:

1. The basic nature of the region in which the land in question is situated, represented by more or less uniform conditions of soil, topography, climate and vegetation.
2. The depth, texture and permeability of the soil.
3. Inhibitory factors such as wet conditions, salinity, stoniness, etc. which may be present in the land.
4. The slope of the land.
5. The extent of erosion to which the land has already suffered.

The information on the above factors for any given land is collected by conservation surveys and the land is classified on the basis of this information. It is obvious that a land, in any region, which is level enough to be erosion free, which has a good depth of soil

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* Paper presented at the conference of agricultural workers in India held at the Indian Agricultural Research Institute, New Delhi on 6-9 April, 1949.

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with texture and permeability conducive to plant growth and which possesses no inhibitory factors, is surely a very good land for the purpose of agricultural production. This is a Class I land and the conservation problem here is the maintenance of soil fertility under maximum exploitation with the help of normal agricultural operations. If on the other hand, all other conditions remain the same but one of the inhibitory factors or causes of soil erosion is present, the land requires more care for its stability than the Class I land. The conservation problem becomes more difficult requiring the introduction of such practices as will overcome the state of instability of the soil together with what is required to maintain its fertility under maximum agricultural production. This is a Class II land. It is clear, therefore, that the intensity or the degree of hazards form the basis of this system of classification. It also follows that as the degree of hazards increases, a stage will be reached when agricultural 'use' of the land may not be a feasible proposition. Such lands should be retired to pastures or forests, if not permanently, at least for some years to come until the intensity of the hazards has been partially or fully mitigated or, as may happen, further scientific knowledge, gained during those years, makes agricultural exploitation of the land possible even under such inherent hazardous conditions.

It will appear, therefore, that enough flexibility has been introduced in this system of classification, and that, at any stage of our existing knowledge, lands can be classified indicating the appropriate use to which each class of land should be immediately put to with a fair degree of accuracy. It is not necessary for the purpose of this paper to go in detail into the various sub-divisions which may exist in this system of essentially a broad national classification. In India the various classes of land under this system still require to be fixed so as to provide a workable basis to initiate the introduction of proper land use throughout the country. In the U.S.A., and certain other South American countries, eight broad classes of land have been recognized. Of these four are placed under agricultural use and the other four under pasture, forest or other uses.

In all the above cases, particularly for the agricultural use group, a considerable volume of research and experimentation was and is still being carried on to evolve suitable supporting practices to enable maximum safe exploitation of each class of land in each region. It needs no mention that a set of practices found suitable for a particular class of land in one region will not necessarily hold good for the same class of land in another region. The intensity of research and experimentation is thus evident but let this not be a disquieting feature in the determination to go ahead at a rapid pace with soil conservation in India. Broad principles on which the supporting practices are to be based are already known in India and elsewhere, and these could be profitably applied at once to effect stabilization of the soil and increase production. In the Bombay-Deccan area contour bunding has been used with considerable success over five lakh acres in light and medium textured soils with an appreciable increase in yield. Improved dry farming methods in Bombay have given as much as 70 per cent increase in yield. Unfortunately data on the increase in yield due to introduction of soil conservation practices are not available in India since it is only recently that such practices have been introduced in very limited areas in this country. However, since the supporting practices in a soil conservation programme have the objective of maximum production in view, recourse will be automatically taken, based on existing knowledge, to all available means of manuring and fertilization, increasing irrigation facilities, suitable crop rotation, etc. the effects of which on crop yield are somewhat better known in India. Thus manures and fertilizers have given an increase in yield from 22 to 128 per cent, irrigation from 30 to 145 per cent and crop rotation from 48 to 114 per cent. Not in all cases requiring irrigation it will be possible to introduce irrigation and the supply of fertilizers may remain inadequate for some time to come, but crop rotation can be introduced in a large number of cases with immediate beneficial effects. In regard to fertilizers if the basic dose of 20 lb. of nitrogen per acre is distributed equally between dung, oil cakes, bone meal, ammonium sulphate and green manure, there may be better chances of meeting the major part of the requirements with the resources that are available or can be developed further in a short time in the country.

It has already been mentioned that the introduction of conservation practices in India is of a very recent origin. They cover only very small areas and are therefore too meagre to meet the need of the country. Furthermore, the meagre work is all piecemeal and not properly coordinated. At each place of such trial, emphasis has been laid on one or two aspects of the problem and sufficient integration has not yet been introduced to bring about an all round improvement for maximum production. Such trials, however, are not without value since they furnish information on which to base later the integrated approach to the problem. Briefly these efforts have been mainly in the direction of:

1. Pasture improvement through the control of grazing and, in some cases, with reseeding.
2. Reclamation of waste lands also by closure to grazing and, in some cases, with systematic planting.
3. Contour bunding and field embankment to conserve rain water. It is only in very recent years that researches have been introduced at a few places on contour cultivation, strip cropping, terracing, contour trenching, gully plugging, etc.
4. Planting of soil-conserving grasses and legumes.
5. Erection of shelter belts against wind erosion.
6. Control of flood and river bank erosion.

In the United Provinces an all phase rural development project has just been launched.

In almost all the cases mentioned above promising results are being obtained, as expected; but the point stressed here is that the sum total of such efforts is extremely small as compared with what it should be and that the work throughout the country should be planned, coordinated and placed under one programme.

On the other hand, there is a considerable volume of information on the benefits that have resulted from proper land use supported by conservation practices in the U.S.A. and other countries. It is not possible to discuss them within the limits of this paper. It will suffice to generalize that an over-all increase of 30†† per cent in production in the conserved areas, over and above previous heavy fertilization, appears to have been achieved. In Russia with the introduction of conservation measures, including crop-grass rotation system, in the steppe and forest-steppe areas, the productivity of the land has been pushed up to 47 to 84 per cent. If conservation measures have given increased yields in other countries, it will not fail to do so in India also. Therefore, taking a very conservative estimate, an immediate average increase of 30 per cent in production can fairly be expected from the areas in which conservation practices are introduced with the added advantage of stable and permanent agriculture. Where irrigation is needed and can be extended, the increase in production will be much higher.

Integrated soil conservation measures

So far as India is concerned this will be a theoretical discussion since a beginning has not yet been made in this direction. But it may be desirable to probe into how other countries, especially the U.S.A., have proceeded in the matter keeping in view any suitable modifications necessary to suit Indian conditions.

In the beginning a large number of demonstration areas were opened and run in many states in the U.S.A.; but it was soon realized that the problem of conservation could not be solved adequately by work in isolated areas, and that it was necessary for the farmers to organize themselves for cooperative action to apply on their lands conservation practices with technical help from the Soil Conservation Service. The help was assured through legislation and soil conservation districts came into being. As soon as twenty-five per cent of the farmers of any area signify their willingness to cooperate with the service in applying soil conservation measures on their farms, the area is included in a district and free technical help as well as help with equipments on hire are made available to the farmers.

The technicians survey each farm, demarcate the different use capability classes of the entire farm land and prepare a plan for the farm indicating the measures to be introduced in each demarcated area, including those of engineering, forestry, crops and crop rotations, pasture improvement, etc. The plan also goes into the economics of the farm and indicates the number of cattle that should be maintained, also poultry, hogs or any other livestock in which the farmer is interested and which can be developed under the conditions of the farm. In fact a complete plan is presented with emphasis on the proper use of each class of land occurring in the farm holding and on the stepping up of production and therefore of the income of the farmer. Furthermore, technical supervision (e.g. in the laying of contours, terrace, diversion ditches, graded channels, tile drains, contour strips, ponds, etc.) and advice in executing the plan is also made available to the farmer free of charge.

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†† Exact figures are not available, but are expected to vary from field to field from 0 to over 30 per cent, the relative increase being more during years of low rainfall.

It may be mentioned that the farmer is fully consulted in the course of the preparation of the plan so as to accommodate his particular wishes, if any, and his initial limitations in regard to labour, equipment and finance. The execution of the plan, therefore, may begin on a small scale; but experience has shown that the farmer somehow manages to get labour, equipment and money in the next two or three years to take up the work on the scale indicated in the plan; this certainly speaks of the quick appreciation in a practical way of the soundness inherent in a conservation plan. More than 2,000 soil conservation districts have thus grown up in the U.S.A. within a brief span of 13 years, and more than fifteen per cent of farmers are practising soil conservation on their farms covering tens of millions of acres. The key to this signal success lies in the personal contact of the technicians with the farmers in the field and making them learn and appreciate the value of soil conservation as they work. No enforcement has been or is being introduced.

Let the subject be now considered for India. In the first place, the small size and the scattered nature of our individual farm holdings make them unsuitable for preparing a farm plan for each holding. The area of a village has been suggested for this purpose. But the rational approach will be the entire area of a sub-watershed with the areas of villages, or portions thereof, that come within the catchment. For the sake of speed, and at the same time without loss of accuracy, a unit of the order of 10,000 acres is considered expedient, so that, if necessary, more than one sub-catchment should be lumped together for the purpose of preparing the plan. The efficiency of the planning staff will not be affected since in any case they will have to meet the farmers in groups. On the contrary, a sub-watershed affords a better scope for drawing up an efficient plan on the basis of utilization and disposal of water.

In the second place our farmers have not the equipment to undertake the execution of the engineering part of the plan, which may call for the use of heavy machinery. However, we have now some information on the type of organization needed to deal effectively with such work on the basis of the working of the Central Tractor Organization. The difficulty in this respect therefore does not seem unsurmountable.

In the third place we have not the requisite number of trained personnel to take up the work on any wide scale. This may be so, but that was also the case with the U.S.A., and for that matter any country when they made a beginning in that direction. In fact, dearth of trained personnel is not likely to prove any serious handicap, if we adopt the principle of getting the men efficiently trained as they work. A short refresher course of about 14 weeks given to a couple of dozens of agricultural, forestry and engineering graduates on the fundamental principles of soil conservation with practical illustration in the field, can bring lakhs of acres under the conservation programme.

In the fourth place we have not enough research data on which to base effective conservation measures, nor have we enough facilities for research to keep feeding the field staff with new and better information. It has been stressed before that broad principles on which conservation practices have to be based are already known to a large extent. In the early stage in India, as was done and is still being done in the U.S.A. and elsewhere, we shall have to depend on the ingenuity of the farmers and the best judgement of the technicians in evolving effective conservation measures to suit local conditions. At the same time, steps could be taken to organize research to solve specific problems as they are presented by the field staff from time to time. The research staff should try to solve the problem on the spot, if they are not already in possession of the requisite information available from experiments carried out elsewhere on similar set of conditions. Cultivators' fields are to be utilized for the purpose and the cultivators guaranteed against losses. Supporting laboratory data for such researches are to be obtained with the cooperation of the existing Central and Provincial Research Stations and Institutes and the Commodity Research Stations, supplementing the staff of these Stations and Institutes, where necessary, by the soil conservation organization. This will of course be a temporary measure. As this work progresses, the volume of problems presented by the field staff will be so great that properly equipped Soil Conservation Research Stations will have to be set up both under the Central and Provincial Governments. In this matter of researches in soil conservation, 'the objective should not be to make them of the cloistered or collegiate type but more of the type carried out in business organization in developing particular products. Furthermore, instead of going in for a complete solution, research on a particular item is to be finished off when something that will work with a reasonable degree of soundness has been obtained', so that research on the next item waiting in the list of priority can be taken up.

But what we do not really have in India is the appreciation of the fact that through the application of soil conservation measures on the field, we can make our agriculture rational, stable and the most productive. And because of this lack of appreciation there is yet no definite policy and no national programme for soil conservation. The position was exactly the same in the U.S.A. until 1934, when, it is said, that while a prominent scientist (now the father of the U.S. Soil Conservation Service) was addressing the House of Representatives to convince the members of the immediate need of a definite policy and a national programme, dust from the dust bowl in the central U.S.A., after travelling hundreds of miles, entered the House and settled on the papers and desks in front of the members. It was not so much the speech of the scientist as the settling of the dust that stirred the members and a fillip was given to soil conservation proposals. Scientists, prominent public men and even newspapers have all stressed the need of introducing soil conservation measures in India. Dust from the Rajputana Desert is blowing into everybody's house in Delhi and even in Simla, but we have not yet sufficiently awakened to one of the most pressing needs of the country.

A national programme of soil conservation

It has already been mentioned that the U.S.A is carrying on a nationwide programme of soil conservation and is profiting by it. A number of South American countries have followed suit. Australia and New Zealand also have done the same. Recently Russia has launched a soil conservation programme of almost incredible magnitude in the South and Central Black-Earth Belt of the European U.S.S.R. The truth is that soil conservation is the basis of permanent and productive agriculture. That being so, India is bound to accept the need for soil conservation on a nationwide scale, be it today or tomorrow. The sooner she does so, the better will it be for her.

It seems justifiable, therefore, to discuss ahead some of the broad lines on which a national programme of soil conservation in India may be based. Some of the difficulties in developing an efficient national programme for India have already been discussed. It has also been pointed out that the acceptance of the programme by the farmers should also be achieved through education and not by enforcement and that this has been found feasible elsewhere by personal contacts of the technicians with the farmers making the latter learn as they work and by granting effective powers to the farmers to organize themselves for cooperative action. Over the greater part of India, in the provinces and States, certain measures are being launched to re-organize the *panchayats* to whom such effective powers may be delegated. In other words *panchayats* are to be made responsible for carrying out soil conservation work within their respective jurisdictions, the services of the technicians being made available to them free of charge.

Let us now try to build up a programme by considering the requirements at successive stages beginning from the bottom. It has been proposed that our farm plan is to be a conservation plan for a sub-watershed with an area of about 10,000 acres. Two points arise here for consideration, one on technical aspect of survey and planning, and the other on the actual survey, preparation of the plan and the execution of the work. In the national programme the former is to be made the responsibility of the Centre so as to ensure a uniform procedure of survey and planning throughout India, while the latter will be the responsibility of the provinces and States.

To start with, the Centre will make rough delineations of the different Basic Soil Regions** (B.S.Rs.) occurring in the country, carry out reconnaissance survey of each B.S.R. to fix provisionally the normal soil profiles and the approximate ranges of slope, erosion and inhibitory factors for determining the various land use classes, make tentative recommendations for the practices necessary for each class of land, based on judgement and local information, and prepare *ad hoc* technical guides for survey and planning. As information becomes available through application of conservation measures on the field, the *ad hoc* guides will be replaced by better ones for use in future planning.

The actual survey and the preparation of the plan for the sub-watershed will be carried out by the provincial or State staff following the procedure laid down in the technical guides referred to above. For this work and the execution of the plan, the province/State should have technical staff at *pargana*, *tehsil*, district and provincial/State levels. These units, at the various levels may be designated as 'work unit', 'work group', 'district unit', and 'provincial/State unit'. Since the object is to secure willing cooperation of farmers, there should be in addition to the *panchayats* at the village level, soil conservation committees at the *pargana*, *tehsil*, district and provincial/State levels consisting of the representatives of the *panchayats* and of the lower committees as we go upwards. The work unit, the work group, the district and the provincial conservationists will be members respectively of the *pargana*, *tehsil*, district and the provincial committees. The exact constitution of these committees is to be left to the discretion of the provincial/State authorities but the point is raised here to stress that effective cooperation of farmers is likely to be forthcoming, if at every stage they are made to feel that it is their programme of work and for their good. At the provincial/State level instead of a 'committee' it may be called the 'Provincial/State Soil Conservation Board'. If the provincial/State Governments introduce rural development boards and committees to secure cooperation of the villagers on the same line as mentioned above, soil conservation should be made a part of the function of those boards and committees. The formation of such boards and committees will indeed be welcome as it will provide for an effective coordination of the activities of the various governmental agencies for rural development. It needs no stressing that maximum agricultural production is achievable when the farmers do not suffer from lack of health, credit facilities, essential supplies, etc.

As soon as legislative enactments have been made to enable farmers to organize themselves for cooperative action through the *panchayats* and committees mentioned above, soil conservation work on the field on sub-watershed basis should be taken in hand. In the beginning each province or State may select three sub-watersheds in three districts with three work unit offices. This is suggested because of the absence of field experience of the trained staff who have just undergone a refresher course of 14 weeks about which reference has been made before. All the trained staff should be distributed between the three work units. Every six months three new sub-watersheds in other districts should be taken up for soil conservation work until the work has begun in all the districts in the province. A target of three years should be fixed for completing the work of each sub-watershed and adequate staff should be provided for the purpose. On completion, contiguous sub-watersheds should be taken up until the entire district is covered. It will be possible after the first two years to start work simultaneously in several *parganas* and different *tehsils* in a district. The point stressed is that in the first two to three years we should proceed with our programme rather slowly and cautiously in order to organize, consolidate and gain experience both in the field work and in handling farmers to secure their maximum cooperation.

Research in soil conservation and the sifting of information from this and other sources all over India and elsewhere should be mainly the

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** Indian Agricultural Research Institute, New Delhi, is preparing map to delineate Basic Soil Regions on the basis of information already available.

responsibility of the Centre. It must keep the field staff at the various levels in the provinces and States fed with new useful information and new ideas continuously so as to improve the efficiency of the field staff. The provinces and States should also share in the responsibility of carrying out research and should maintain research stations and nurseries. The main research activity of the provinces /States will be the quick solution of specific problems presented by the field staff. A very close cooperation should be maintained between Central and provincial research staff so that coordination of work could be effected throughout India and duplication is avoided.

The training of personnel required for the field work, through a 14 weeks refresher course, should receive top priority in the national programme and should be the sole responsibility of the Centre in the beginning. Later on the provinces and States will train their own staff, but the preparation of the course of instruction will remain the joint responsibility of the Centre and the provinces /States. It may be desirable to invite Central staff to take part in the teaching from time to time.

It will be thus seen that at the Centre there must be a fact finding, planning and coordinating organization. The establishment of such an organization should receive the topmost priority in the national programme. The next priority will be the preparation of *ad hoc* technical guides for soil conservation planning of sub-waterhseds and the training of the field staff. Meanwhile legislation should be enacted to enable farmers to organize themselves for cooperative action through *panchayats* and other committees at *pargana*, *tehsil*, district and provincial /State levels. As soon as this is done, soil conservation work should be started in three sub-watersheds in three districts, adding three more sub-watersheds in other districts every six months until the work has begun in all the districts in the provinces or States. On completion of the work in a sub-watershed for which a target of three years may be fixed, contiguous sub-watersheds should be taken up until the whole district is covered. In the meantime research and continued dissemination of useful information to the field staff on a country-wide scale should be pursued vigorously by the Central organization.

The above is a broad outline of a proposed national programme. It is by no means complete, but it may serve as a basis for further discussion and improvement.

In conclusion, it may be repeated that the introduction of the integrated soil conservation work is long overdue in India and that the sooner she takes it up on a nation-wide scale the better will it be for her. 'Every day of delay in applying conservation to the land means just that much more loss of food for the people, now and in the future, and it means also, a more difficult and expensive job.'

BEARING HABITS OF KAGHZI LIME

By S. N. SINGH and B. S. TOMAR

THE necessity of an accurate knowledge of bearing habits of any fruit tree is essential for a successful production of blooms and fruits. Factors like nutrition, temperature, moisture, etc. being not limiting, each variety will manifest its characteristic flowering and fruiting behaviour.

Kaghzi lime (*Citrus aurantifolia* Swingle) is by far the most popular citrus fruit in India and is commonly grown in all parts of the country, specially under tropical and subtropical conditions. An investigation was therefore carried out in the Botanical Garden, Government Agricultural College, Kanpur, during the years 1945-47 on the bearing habits of this fruit tree under the following three heads:

1. Vegetative growth,
2. Floral biology, and
3. Fruit study.

Two parallel sets of observations were made, one on 6-year-old trees and other on 13-year-old ones. The selected trees in each set were uniform with regard to their vigour and productivity. All the trees received uniform cultural treatments throughout the course of investigation.

Vegetative growth

New shoots and their further extension: No sooner, the vegetative buds emerged, than they were tagged and their subsequent growth measurements were recorded till the cessation of growth. At first growth started at a slow rate which gradually increased, then slowed down and eventually the growing point abscised (Fig. 1); further extension of these shoots took place by growth of the lateral buds. Three types of shoots resulted from growth of these lateral buds. First, purely vegetative shoots; secondly, shoots having normally developed leaves with flower clusters; the third type of shoots were very short bearing one or more flower buds. Some of these flower buds were subtended by scaly leaves, while others by stunted leaves which dropped before the flowers opened, making the shoot look like a pure inflorescence.

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Periods of vegetative growth: For determining the periods of vegetative growth, four sample branches were selected both on young and mature trees in the month of January 1946. Weekly counts of shoots in growing condition on these branches were recorded throughout the whole year till the period of quiscence. These periodical counts are plotted in Fig. 2, showing the different periods of growth.

It appears from Fig. 2 that new growth of shoots appeared in definite cycles or periods, there being four and five cycles on mature and young trees respectively. With mature plants, the first period of growth began from the second week of January and ended in the third week of February; the second period occurred during the last week of March and April; the third during second week of June and last week of July; while the last from first to third week of August. On the other hand, in the case of young plants, first period of growth started from first week of January and ended in the second week of February, though one or two shoots appeared during the following weeks of February also; the second period commenced from the second week of June and continued till second week of July; the third from third week of July till third week of August; the fourth during the last week of August and third week of September and the last from third week of October to third week of November. Thus it would appear that not only the number of flushes but their time of appearance and duration also differed on young and mature trees.

Performance of shoots of different flushes: From the time the selected shoots were marked off, their behaviour with respect to bearing was noted every week. Their rest period prior to flowering was also recorded.

The shoots appearing after the June flush on young plants did not bear flowers until the commencement of following spring season.

Majority of the shoots of the January and June flushes produced flowers in the following spring, but a few of them bore flowers even before. It was further noticed that every shoot remained dormant for a period of at least 1·2 months before it flowered. The period of dormancy varied in certain cases up to 11·6 months. In mature plants also, the behaviour of shoots in this respect was more or less similar.

Behaviour of shoots after flowering: Out of the shoots which flowered in January, fruits matured only on 58·6 per cent; while from the remaining shoots, all the flowers either dropped or did not reach maturity. These shoots, however, showed a comparatively vigorous vegetative growth during the subsequent months, bearing a higher percentage of flowers in the following spring thus showing an inverse relation between growth and productivity as shown in Table I.

TABLE I

Behaviour of shoots after flowering

Total No. of shoots observed		No.	Condition of shoots in the following months	No.	Condition in following spring	No.
87	Shoots on which fruits matured	51	(a) New growth	15	Shoots flowered	14
			(b) No growth	36		
	Shoots on which no fruits matured	36	(a) New growth	19	Shoots flowered	22
			(b) No growth	17		

Floral biology

The flowers of Kaghzi lime are of two kinds—one with perfectly developed pistils and the other with imperfectly developed or rudimentary pistils.

Perfect and imperfect flowers: Daily counts of the perfect and imperfect flowers were made on four sample branches of the experimental trees from August 1945 to March 1947. The data are presented in Fig. 3.

There appeared a marked variation in the percentage of perfect flowers in the two flowering seasons, the imperfect flowers varied from 10·93 to 93·07 per cent, the minimum being in the month of July and the maximum in the spring season; the perfect flowers varied inversely.

It was also noticed that in the beginning of the flowering period a larger number of perfect flowers opened but as the season advanced they were replaced by imperfect flowers with which the blooming period ended.

Anthesis: Hourly observation on some flower buds due to open were made from morning before sunrise. Flowers which could not complete the full process of opening till the evening of the same day were attended to at night. Such flowers remained in the same state all over the night and resumed the process of opening in the next morning, which was completed by 9 a.m. Flowers of this kind were hardly one or two in number and did not affect the general opening time. The flowers started opening from morning and continued till evening. The majority of the flowers opened before 12 noon, and the maximum was recorded between 11 a.m. and 12 noon.

Dehiscence of anthers and stigma receptivity: The dehiscence of anthers was noted in relation to the opening of flowers. Flower buds which were due to open next day were tagged in the evening. On the following day observations were started from the morning and continued till the evening. It was observed that the dehiscence of anthers took place before, or within 45 minutes to five hours after the opening of the flowers, while the stigma became receptive 15 minutes to two hours before, or within 35 minutes to five hours after the opening of flowers depending upon the weather conditions.

Pollen viability: Viability of pollen grains was determined by acetocarmine test. Observations taken on different dates during the course of study showed that there occurred a

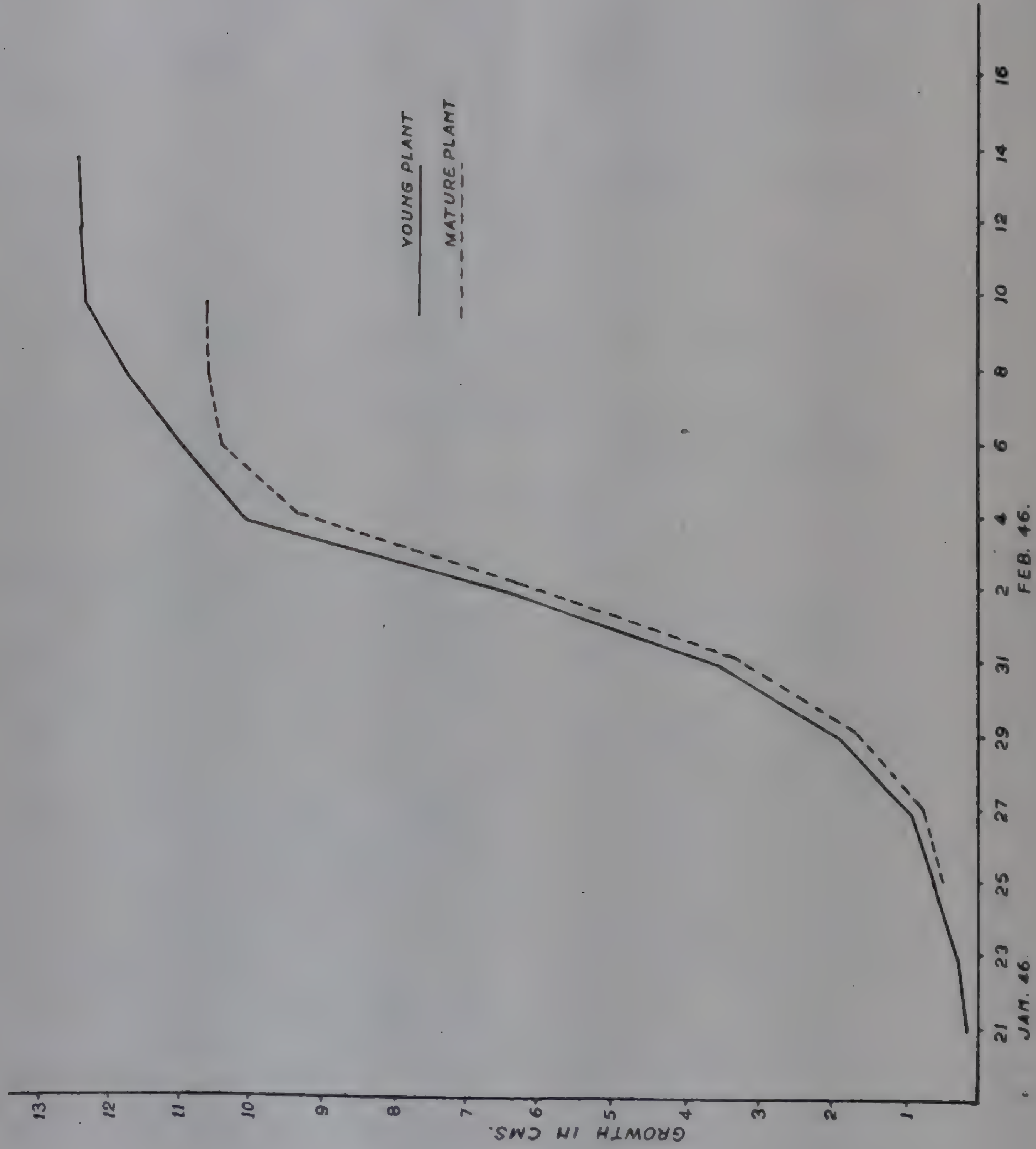

FIG. 1. Showing the growth rate of shoot

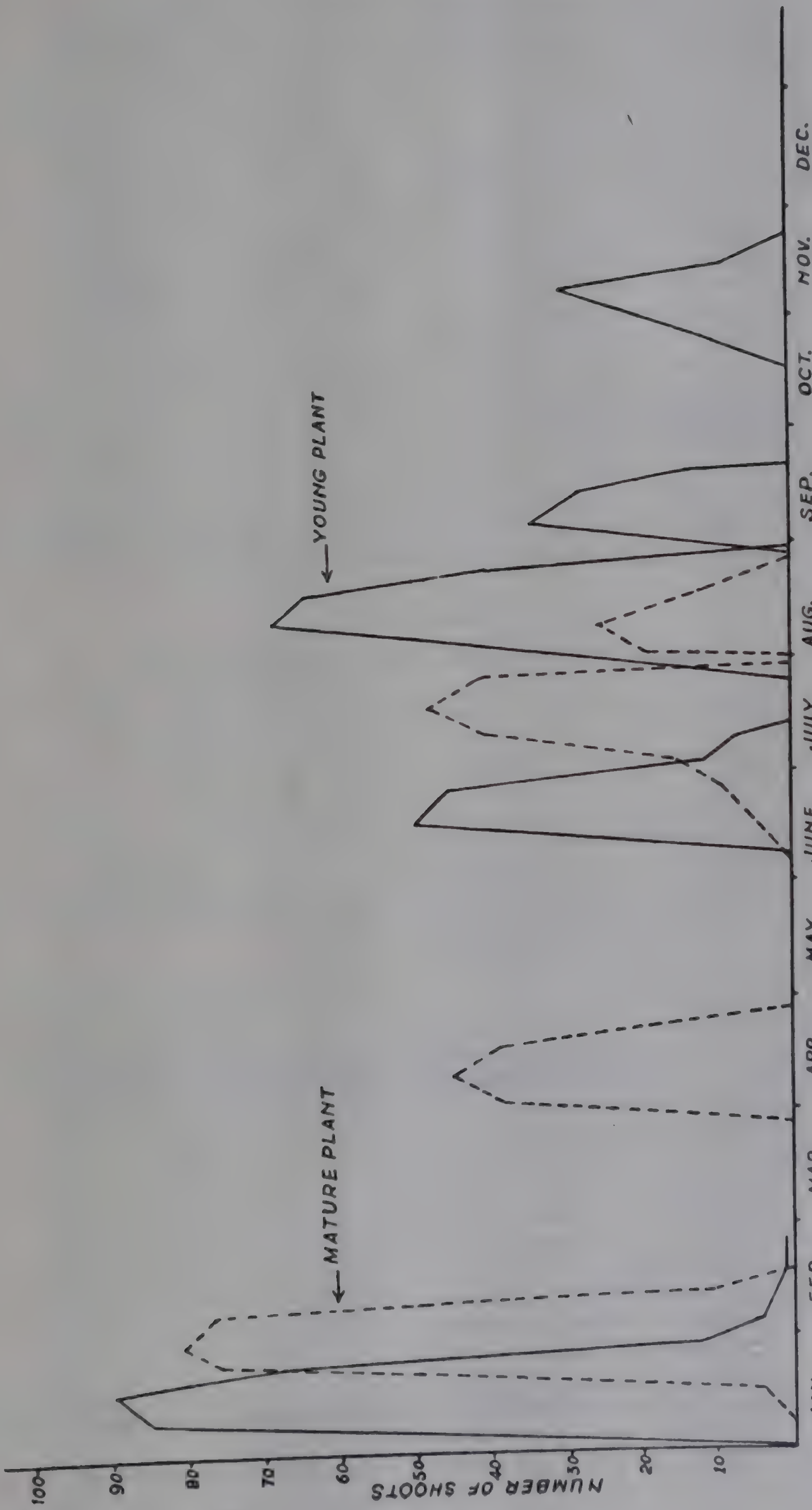

FIG. 2. Showing the periods of vegetative growth

marked variation in the percentage of viability of pollen grains from month to month. It varied from 45·26 to 81·23 per cent, the minimum being in June and maximum in October.

Longevity of stigma: The longevity was determined by examining the stigma with a hand lens and also by germinating pollens on the stigma. The receptivity was found to last from four to eight days in different months, the minimum being in the month of April and the maximum in December and February.

Self-compatibility or self-incompatibility: The anthers before opening of the flowers remained in close contact with the stigma covering it completely from all sides and as such the flower structure is ideally suited for self-pollination in the absence of insects. Hence to know whether Kaghzi lime with all its contrivances for self-pollination is self-compatible or not, 178 unopened flowers were bagged. Out of these bagged flowers, 20·22 per cent matured into fruits, indicating that there is no self-incompatibility. Further, when the flowers were left unbagged 21·5 per cent matured into fruits showing that the insects are neither necessary for pollination nor their presence has any effect on fruiting.

Blooming period: 'Kaghzi lime to some extent is a continuous bloomer producing some flowers during all the months of the year.'[*] For studying blooming period of this fruit under local conditions, the total number of the flower buds appearing in each month on four sample branches of each of the two young trees were recorded. The results obtained (Table II) would reveal that although flower buds are produced almost throughout the year, yet there are two distinct flowering seasons, one in spring—the heavier flowering, and the other in June and July—the lighter flowering, which are popularly called *Ambe Bahar* and *Mrig Bahar* respectively.

TABLE II

Number of flowers which opened in different months

January	February	March	April	May	June	July	August	September	October	November	December
471	621	148	26	3	14	97	30	*nil*	5	3	*nil*

Size and productiveness of the inflorescences: The size of the inflorescence was reckoned by the number of flower buds present on it. The fruits which matured from the inflorescences of different sizes were counted and the percentage of fruits that matured was calculated. The data are given in Table III.

The number of flowers per inflorescence ranged from one to ten. The greatest frequency was of inflorescences which bore a single flower bud, and the frequency decreased more or less uniformly as the number of buds on inflorescence increased. Further it would appear from Table III that there exists an inverse relation with the size of inflorescence and the percentage of mature fruits. The percentage recorded for 10-bud inflorescence is rather an exception due to the fact that the number of flowers was much fewer in this than in the other classes. This shows that there is a keen competition for nutrition between individual flowers and hence the greatest percentage of mature fruits was obtained on inflorescences which had single flowers. Similar results were obtained by Reed [†] in the case of lemon.

TABLE III

Size of inflorescences and their productiveness

Size of inflorescences (No. of buds per inflorescence)	Total No. of inflorescences	Total No. of fruits matured	Percentage of mature fruits
1	444	38	8·5
2	100	8	4·0
3	87	13	4·9
4	93	9	2·4
5	88	13	2·9
6	73	14	3·1
7	27	2	1·05
8	21	3	1·7
9	9	1	1·2
10	5	3	6·0

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[*] Webber and Batchelor (1943). *The Citrus Industry*, Vol. I.

[†] Reed (1919). *J. Agric Res.* **17**, 153-65.

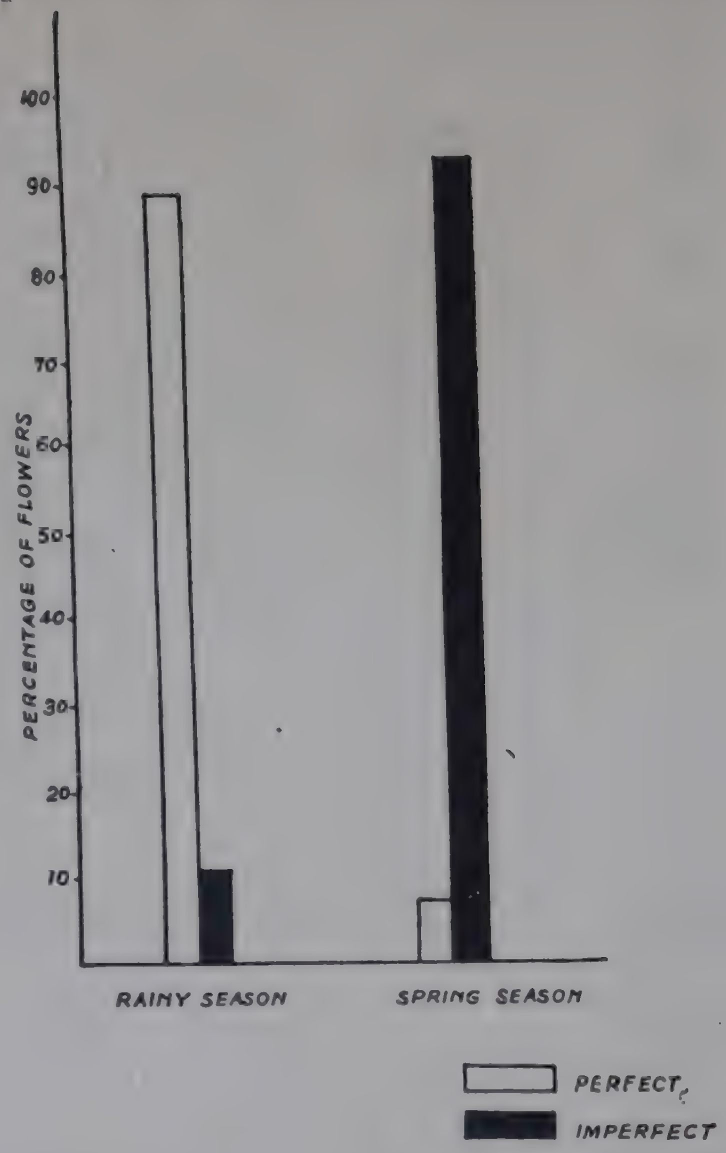

FIG. 3. Showing the distribution of perfect flowers in different seasons

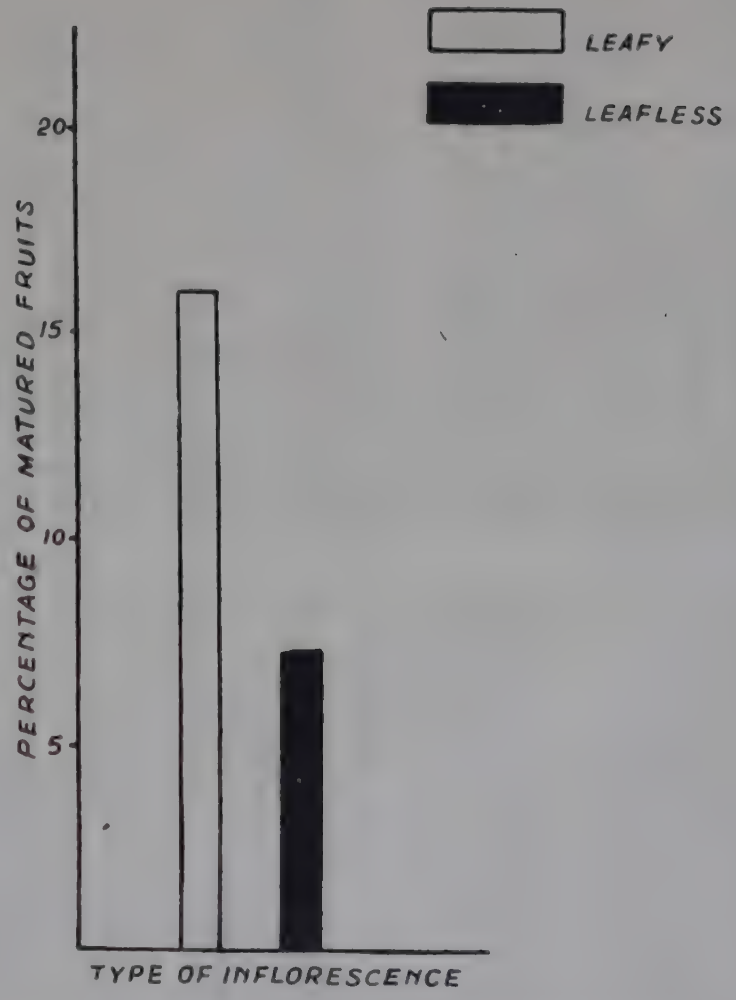

FIG. 4. Showing the productivity of different type of inflorescences

Type of inflorescences and their productivity: The two types of inflorescences, namely leafy and leafless, show variation with regard to their productivity. The percentage of perfect flowers and mature fruits on leafy inflorescences were higher than those on others (Fig. 4).

This higher percentage of mature fruits on the leafy inflorescences was firstly due to the higher percentage of perfect flowers and secondly, probably on account of readily available food from the adjoining leaves.

Fruit study

Fruit setting and period of ripening: Flowers appearing in different months were tagged and the time of opening of individual flower was noted. Record of such flowers which matured into fruits were maintained and the data obtained have been shown in Table IV.

TABLE IV

Period taken by the flowers to mature into fruits

Months in which flowers appeared	January	February	March	April	May	June	July	August	September	October	November	December
Average time taken in months	7·0	5·6	5·4	5·2	5·6	5·0	4·3	4·7	5·7	..	7·8	9·0

The examination of Table IV shows that fruits which develop from flowers appearing in the month of July came to maturity in the minimum time, 4·3 months; whereas flowers appearing in December required the maximum time, 9·0 months. Thus, there was a variation of about 4·7 months in the average time required to produce a mature fruit. The fruit was considered mature when it turned from green to pale yellow. It is thus evident that the month, in which flowers open, influences the period of maturity. The results are in conformity with those of Reed †† in case of lemon.

From the record of harvest of mature fruits during different months of the year, it was found that there were two main seasons of ripening: the first from July to August and the second from November to December, although some fruits ripened all the year round. Of these, the first one accounted for the bulk of annual production.

Acknowledgment

Our sincere thanks are due to Dr D. N. Srivastava for his valuable suggestions and criticisms.

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†† Reed (1919). *J. Agric. Res.* **17**, 153—65.

SUGARCANE TOPS AS CATTLE FEED IN THE UNITED PROVINCES

By N. C. DAS GUPTA

MORE than 50 per cent of the total sugarcane produced in the Union of India is grown in the United Provinces. During the year 1943-44, the estimated area under sugarcane in this province was 2,240[1] thousand acres. If the average yield is taken as 354 maunds (12·96[2] tons) per acre, the total quantity of sugarcane produced per year in the United Provinces would be 793 million maunds. This can supply 88·1 million maunds of tops if the proportion of tops is taken as one-ninth of the cane. On the basis of average 200 maunds per acre, it will require 440·5 thousand acres to produce green fodder equivalent to the amount of the sugarcane tops available. This is of great importance when it is found that approximately 1,604 thousand acres, only 3·6 times more than the area equivalent to the amount of the sugarcane tops, are usually put under fodder crops in the United Provinces. The value of sugarcane tops as forage will be further enhanced if the fodder position of the country is considered. In a recent survey, the writer[3] has estimated that in the United Provinces there is a shortage of 51 and 77 thousand tons of dry matter and digestible protein respectively for adequate feeding of the livestock. The amount of net energy required is also short by 66 per cent. In these circumstances it will be of great help if sugarcane tops can be used as forage. The tops are not usually utilized as cattle feed and, instead, a major portion is burnt as fuel during *gur* (raw sugar) manufacture and also for thatching purposes. The whole tops are sometimes fed to bullocks, but they are never used for milch cattle. The unpopularity of the tops is mainly due to the common belief that leaves of sugarcane are detrimental to the production of milk and also because of want of information about the nutritive value of tops. Hence, an experiment was conducted to study the nutritive value and the effect of sugarcane tops on production of milk. Tops of sugarcane Co. 312 were used for this purpose.

Digestibility of nutrients

For want of any green fodder at the time of the test, it was not possible to compare sugarcane tops simultaneously with some of the known cultivated fodders. Stockowners usually feed straw or *karbi* during this season along with oilcake or some other concentrate. Hence, the concentrate saving effect of feeding sugarcane tops as compared to a ration of cake and straw was also studied. For this purpose straw supplemented with linseed cake for protein requirement was compared with sugarcane tops supplemented with half the quantity of required linseed cake. Wheat straw was used in the test.

It was found that in spite of the presence of 50 per cent reduced linseed cake, the digestibility of the nutrients of the total ration with sugarcane tops compared favourably with that obtained with double the quantity of linseed cake when fed with straw. The digestion co-efficients obtained for the nutrients of the total ration have been shown in Table I. Digestibility of sugarcane tops has also been calculated.

Digestible nutrients as compared to other fodders

Though the digestion test was conducted during the month of April when the sugarcane tops were over-ripe, it was found that the total digestible nutrients of the tops tested

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[1] *Estimate of area and yield of Principal Crops in India* 1941-42, 1942-43 and 1943-44 Department of Commercial Intelligence and Statistics, India.

[2] *The report on the Survey of Sugarcane Research in India*, N. L. Dutt (1946).

[3] A Survey of the Feeds and Fodders and the requirement of the Livestock in the United Provinces, *Indian J. vet. Sci.* **17,** N. C. Das Gupta (1947).

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were nearly equal to maize and compared quite favourably with other cultivated fodders such as elephant grass, guinea grass and *chari* (*Sorghum* fodder). Therefore, as far as the digestible nutrients are concerned, sugarcane tops should get at least the same preference as the other cultivated fodders. The figures obtained for the sugarcane tops have been compared in Table II with those of the other green fodders.

TABLE I

Digestion co-efficients

	Protein	Ether extract	Fibre	Nitrogen-free extract
Reduced linseed cake along with sugarcane tops ...	68	77	74	72
Full linseed cake with wheat straw ...	75	75	58	59
Sugarcane tops alone	57	76	74	72

TABLE II

Digestible nutrients (lb.) per 100 lb. dry material

Fodder	Crude protein	Ether extract	Carbo-hydrates	Total digestible nutrients
Sugarcane tops ...	3·3	2·4	58·3	66·8
Elephant grass ...	3·9	1·3	48·5	55·4
Guinea grass ...	4·1	0·7	46·0	51·6
Chari (prime) ...	2·6	0·7	50·8	54·9
Maize ...	4·4	1·2	61·0	68·0

Effect on milk yield

The test to study the effect of sugarcane tops on milk yield was conducted for 10 weeks. During the first five weeks, one lot of three Hariana cows received linseed cake along with wheat straw and the other lot of three animals was under sugarcane top ration in which the cake was reduced by 50 per cent. During the next five weeks the treatments were interchanged, thereby, having all the six cows under both the treatments for five weeks. When the milk yield of the first week after each change of ration was ignored, to avoid any carry-over effect, it was observed that all the six animals produced 1,084 lb. milk when receiving sugarcane top treatment as compared to 973 lb. with full linseed cake fed with wheat straw. This indicates that the production of milk with sugarcane tops even with 50 per cent reduction of oilcake, is superior to full linseed cake fed with wheat straw and, as such, one accustomed to feed wheat straw should not hesitate to feed sugarcane tops to the milch cows.

Economy

For production of 1,084 lb. milk, 253·6 lb. linseed cake had to be fed as against 539·5 lb. with wheat straw which produced only 973 lb. milk. The economy of the two treatments cannot be compared as the wheat straw had to be purchased whereas, the tops were the by-product of the farm. But, for the stock owner who is in a position to feed either of the two roughages, feeding sugarcane tops will save a lot of concentrate. The milk yield figures show that under the experimental conditions, 23·4 lb. linseed cake was required per 100 lb. milk yield with sugarcane tops as compared to 53·5 lb. with wheat straw.

IMPROVEMENT OF NUTRITIVE VALUE OF WILD GRASSES

By R. C. KAUSHIK

NOTHING has so far been done to find better varieties in grasses or to study the possibilities of crossing various species of wild grasses to improve their nutritive value. Breeding has produced marvellous results in the case of wheat and sugarcane in which the maximum yields per acre and the highest possible sugar content were the objectives. Wheat and sugarcane are also grasses and there is no reason why research cannot be taken up to improve the nutritive value of wild grasses by selection and breeding on the same lines.

Important factor

Soil fertility is an important factor which determines the nutritive value of wild grasses. Researches by Lander and Dharmani have shown that the same species of wild grasses show not only different chemical compositions but also differences in digestibility if grown on soils with significant differences in fertility. Grasses from Kangra Valley were the objects of study and it was found that samples from badly eroded areas were poorer in feeding value. Similarly, it is a well known fact that the famous Hariana and Hissar breeds of cattle owe their stout bones and strong structure to the abundance of calcium in the soil of their tract. Wild grasses growing on soils rich in calcium are better in feeding value not for calcium alone but from the point of view of other mineral nutrients also because carbon dioxide gas given out by lime digests and dissolves the minerals. High organic content of soil produces a better vegetative growth with dark green colour. Protein contents of fodder grasses from soils rich in organic matter and humus are bound to be higher. In short, management of grass lands with a view to maintain and improve soil fertility will automatically result in improvement of the nutritive value of wild grasses. If suitable types of leguminous wild fodders are grown as a mixture, nutritive value of the grasses and the soil fertility will show definite improvement.

Nutritive value

In all grass lands various species of grasses of different nutritive values are found growing side by side. If the proportion of grasses rich in feeding value is increased by broadcasting seed, with light soil-working, and by weeding out the poorer grasses before ripening of seed, by any means physically and economically possible, automatically the combined nutritive value of wild grasses from a grass land will improve considerably. It has been observed that after a complete closure against grazing, wild grasses show a striking improvement in the mixture of species, the period during which each species remains green, and the yield; also that grasses stand for a longer period in a closed area than outside it and yield much more maundage per acre. This natural change for the better is a gradual process and, definitely, is the result of improvement in the soil. With the increase in vegetation after a closure, soil erosion is reduced and accumulation of organic matter starts resulting in the improvements in the absorptive capacity and moisture retentivity of the soil. A cycle of improvements is thus set up. Due to the closures, grasses and other plants get a chance to develop and spread; this improves the soil and the improvement in the soil influences the vegetation. Not only the size and density of each species is favourably affected but the replacement of inferior species by better ones also commences. Grasses are readily and beneficially influenced by closures. Undoubtedly the nutritive value of the persisting grasses is improved; general improvement by the coming in of better grasses with higher nutritive value is, however, also evident.

Harvesting

The stage at which wild grasses should be harvested is extremely important from the

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point of view of full utilization of the nutritive elements. Wild grasses start seeding in September; by the end of October the seed ripes and the grasses start drying up. Nutritive value shows a decline from the time of seed-setting; by November the dry grass is more or less useless nutritively. Unlike Europe, where grasses are harvested for hay just as the seed formation starts, in the hills of the East Punjab wild grasses are harvested much too late. The main reason is that the villagers remain busy with their crops during September and October; and the fact that hay from green grass is far more valuable than that from dry mature grass is not known to them. The remedy therefore lies in teaching the art of hay making to the villagers and in adopting measures which will delay the ripening of grasses to enable late harvesting. Supply of more moisture is the only way to delay ripening; and this can be attained by adopting various water conservation devices like contour trenching, contour bunding and planting of trees and hedges. The retention of more rain water in the trenches and behind the bunds and reduction of loss by evaporation brought about by trees and hedges will add to the available soil moisture. Thus a month or six weeks can be added to the period during which the grasses remain green so that even in December, when villagers are free to undertake harvesting, grasses will still retain a sufficiently nutritive value.

In short a considerable improvement in the nutritive value of wild grasses from the wastelands is possible, even without new and better strains or breeding work, if scientific management, embodying all the suggestions given in this note, is resorted to. The wastelands are being used for uncontrolled heavy grazing at present and, therefore, their production is just a fraction of their potential capacity.

CATTLE PURCHASE SUBSIDIZED

TO encourage Northern Territory cattlemen to improve their stock, a substantial subsidy has been granted by the Australian Government on stud cattle imported into the Territory from other States or from overseas.

Subsidy takes the form of a pound-for-pound contribution by the Government to all freight and transport charges.

This means that Northern Territory graziers can import expensive pedigree bulls at big savings.

Six prize shorthorn bulls have already arrived from Scotland, the first imported stud stock to reach the Territory for twelve years. Each cost 2,000 guineas.

Ambitious plans to develop the cattle industry on the great grazing lands in the north involve tremendous work on improvements, and the introduction of new blood, and it is expected that the next few years will see large numbers of stud cattle imported, mainly from Britain.—*Australian Agricultural Newsletter*, No. AGN/266.

IMPROVING INDIAN HIDES

By A. P. PALIT

SINCE partition India has to face shortage of good hides. This will be still greater when the proposed ban on the slaughter of useful cattle is given effect to. Though only about 25 per cent of the total production of hides in undivided India was from slaughtered cattle, this small percentage nevertheless contributed largely to the importance of the export trade and also the local tanning industry. The anticipated fall in the supply of such hides should have therefore been viewed with much concern by the leather trade. For a few years, of course, slaughtered hides will be available from Pakistan though at a higher price but that source cannot be depended upon as long as she has apparently given priority to the development of her leather industries. We shall have therefore to turn back to our own resources and tap all means to improve both quality and quantity of production. True, slaughtered hides cannot be replaced by fallen hides, i.e. those collected from cattle dying naturally or of disease however much care may be taken for such collection; but still a great deal may be done and perhaps the loss more than compensated, if due attention be paid to improving the quality of the fallen hides which constitute 75 per cent of the total hide production in undivided India. Our export trade of raw hides may receive a setback or the quality of our chrome leather may somewhat deteriorate for want of good slaughtered hides; but, on the other hand, the vegetable tanning industry which accepts hides without much discrimination as to quality will be immensely benefited when the average quality of 'fallen' hides is improved. The proposition thus presented is not very difficult to attain, if only a little attention is directed towards this by the public at large.

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Present condition of hide trade

At present hide trade and all that is connected with it are in a neglected condition. The hide producer is a taboo to the society. It is therefore not surprising to find the hide producers giving up this job *en masse* with a view to gaining status in society. The writer had an occasion to meet a Harijan drunkard who had given up his traditional occupation of flaying. Asked as to why he gave up flaying, he said that their community was subjected to bitter hatred by higher classes of people. Asked again as to why he was not similarly treated because of drinking, his spontaneous reply was that there was nothing wrong in drinking and even the Brahmin was addicted to it. Thus our society has goaded the poor man and his community to give up an honest source of income and has, at the same time, added to his misery in various ways. Thousands of hides are being wasted unflayed because of the attitude on the part of flayers, although we have to import hides for our tanneries from other countries.

Indifference, neglect and ignorance

The story of hide production is replete with instances of indifference, neglect and ignorance. But these are never taken seriously because the people concerned are quite used to this state of affairs. First of all utmost indifference is shown to the hide of the cattle belonging to him by every Hindu of the higher castes as he does not usually get anything in return. Whether the poor *Chamar* gets more money or less from the hide, is of little concern to the cattle owner. That is why he does not hesitate to disfigure the body of the cattle on various traditional grounds. He brands them in various ways with red hot iron. In certain parts of the country, according to the prevailing custom, when the cattle is dead, it is dragged on the ground out of its shed for about

20 yards and then only the *Chamar* is allowed to carry it away. The result is that one side of the hide is seriously scratched.

Then, when the *Chamar* is absent, jackals and vultures have to be reckoned with and occasionally also the heated ground on which the carcass lies. Vultures damage the upper side of the hide while the heated ground, the lower side. If however the *Chamar* happens to be timely informed about the death of a cattle, and has sufficient number of assistants in hand to carry and flay the carcass (which occurs only in about 40 per cent of the cases), he has no salt to apply to the hide. He has therefore either to keep the hide as such till the purchaser comes to his door, or to dry it up either in the sun or by the fireside. In the former case the raw hide gets partially or fully putrefied as the purchaser seldom arrives in time, while drying in the manner referred to often damages the hide beyond recovery.

The producer and purchaser

Next comes the purchaser's turn. He is a middleman between the producer and hide merchant. He tries to extract as much as possible from both the parties. He encourages the producer to leave flesh on the hide while flaying so that the hide will weigh heavier and fetch a higher price. But this and other materials like dung, clay, sand, chalk, etc. which he further loads the hide with, hasten putrefaction considerably. The damage caused during transport on railways is also to be taken into account. Before loading and after unloading at roadside railway stations, hides are left uncovered in one corner of the platform under rain and sun, with nobody to look after, except dogs in daytime and jackals at night. In summer the steel wagons which carry hides almost fry them, while during the rains, if they are subjected to drenching before loading in wagons, very often they get putrefied.

This is in short how hides in India are produced and assembled.

It is undoubtedly true that the majority of the people in this country are not interested in hides. It is also true that income from hides is confined only to a minor section of the people. But how many, it may be asked, are equally disinterested in leather? How many in India have now no inclination to use any leather goods? Is not footwear going to be a basic necessity very soon? For those who use footwear, is not the expenditure on this item as high as that on clothing? Are not people particular about the quality of the leather when they purchase footwear? If so, our people should change their attitude towards the hide and consider it as a national asset. Their treatment of those who deal in hides should be sympathetic. Then only men with ideas and men from other classes of people will take to this trade. This way lies the possibility of emergence of the trade from the present sorry state.

Changing the old system

The old system of hide collection needs a thorough overhaul. Hitherto the attraction for the *Chamar* was not only the hide but also the flesh, but it needs to be mentioned that he will give up the practice of eating the flesh of a dead cattle before long. In that case the hide alone will not be paying enough; unless the *Chamar* gets some extra remuneration for the removal of the carcass from the owner's house. But then the flesh, tallow and other useful materials in the carcass will be wasted. It is therefore suggested that in each village, or in a group of villages within a radius of three miles or so, a squad for the disposal of dead cattle be formed under the supervision of the village *panchayat*. The dead cattle should be considered as belonging to the village as a whole and should be removed to the disposal centre by the owner or by the squad at the owner's cost. So long as other people do not come forward to work in the squad, the village *chowkidar* should be so selected as would not mind doing the work of cattle disposal. At the disposal centre, which should be at a fixed place on the outskirts of the village, there should be a shed and a few equipments such as flaying knives, boiling pan and bone-crushing *dhenki*, all of which may perhaps be provided at the first instance by the Government, at least in a few selected areas. Manure will be made out of the bones, blood, flesh, horns, hoofs and intestinal matter; tallow will be extracted which may be usefully utilized in soap making. The hide will be properly and timely flayed and cured. The villagers will then realize that the income from the carcass depends on how the dead cattle has been treated.

Such defects as brand marks, dragging marks, etc. which are caused without any plausible reason or forethought, will gradually be eradicated. The manure obtained may be divided among the villagers with perhaps a larger share for the owner.

It is heartening to see that the Leather Research Committee of the Council of Scientific and Industrial Research in a recent meeting has passed a resolution for establishing cattle disposal centres. The sooner such centres are widely established, the better it would be for the hide and leather industry and also for the agricultural development of the country.

AEROPLANES AID PRIMARY PRODUCERS

THE aeroplane has become a powerful ally of Australian primary producers. Aircraft are now being used to, lay baits for dingoes (wild dogs); spray pest and disease affected crops; spread fertilizer; transport workers, goods and stock; combat bush fires; and round up stock.

During the past twelve months, successful air strikes have been made against dingoes in three Australian States. In Queensland, where it is estimated that each year 500,000 sheep have been destroyed by dingoes, causing an annual loss of £A 2,000,000 to graziers, a chartered Dragon Rapide aircraft laid 2,000,000 poisoned baits over a 42,000 mile line of flight. Baits were distributed from 25 aerodromes, involving 98 flights, which covered about 28,750 miles in Queensland, and 12,320 miles in the Northern Territory.

In South Australia and Western Australia smaller aerial campaigns were waged against the dingoes.

The value of aircraft in crop dusting is becoming more firmly established each year. Crops of linseed, barley, oats, and strawberry clover pasture, have been dusted, usually from Tiger Moth aircraft, against the attacks of various forms of cut-worms, while farmers have reported successful 'kills' of earth mites after aerial spraying with DDT dust. The cost of this spraying has been between £A 26 and £A 30 an acre.

Recently a Royal Australian Air Force helicopter began a series of crop dusting tests which have served a dual purpose. They have tested the efficiency of the machine and of the dusting apparatus specially designed and constructed by R.A.A.F. personnel, and have familiarized helicopter crews and agricultural officers with each other's requirements and limitations.

One interesting fact to emerge from the tests is that the helicopter can direct insecticide full on to the target area with excellent results while operating in a 15 m.p.h. wind. Other aircraft have found it impossible to carry out crop dusting effectively with winds even lower than 15 m.p.h. and have had to wait for windless weather before beginning dusting.

Increasing use of aircraft is being made in the Australian sheep-raising industry. This season a team of shearers chartered an aeroplane to fly them over 2,000 miles to Noonkanbah station in the north-west of Western Australia, and took the wool clip back with them when they had finished the contract. This meant that the clip arrived in Perth two months earlier than in previous years. Farmers fly their sheep to agricultural shows in all States and from stud farm to sheep-raising properties, and even use aircraft to round up sheep. One Queensland grazier uses an Auster aeroplane instead of stock horses on his 92,000 acre property. By low flying he can set sheep running in any given direction and keep them moving.

Bristol freighters are now operating a regular wool transport service from the island States of Tasmania to the mainland. In six weeks, they have carried over 1,000 bales of wool of a gross weight of 35,000 lbs. Buyers say they prefer air freighting since although actual freight charges are higher by air, this expense is offset by speedy delivery and saving in shortage and handling charges.—*Australian Agricultural Newsletter*, No. AGN /269.

INVESTIGATION OF BLAST AND FOOT-ROT DISEASES OF RICE IN MADRAS PROVINCE

THE scheme financed by Indian Council of Agricultural Research came into operation in 1943. The diseases, blast caused by the fungus *Piricularia oryzæ* and foot-rot caused by the fungus *Fusarium moniliforme,* cause considerable damage to the rice crop in the province. While the first disease is widely distributed throughout the province, the second has been found to occur in some districts only.

Blast

The work on blast disease of rice consisted mainly in testing the various strains under field conditions for resistance in close proximity with a high susceptible strain (Aduthuria 10) for promoting rapid multiplication of the fungal inoculum and consequent infection of the other varieties tested. Of the large number of cultures tested over the past six seasons at Coimbatore, 35 long duration rices showed a high degree of resistance to blast. Among these, two cultures, found suitable for cultivation in the districts of Tanjore, Tiruchirapalli and Mathurai, have been released for general cultivation under the names of Co. 25 and Co. 26.

Another aspect studied was the effect of application of varying levels of nitrogenous manures on the incidence of blast. Results of the last three seasons indicate that the application of excessive doses of nitrogen in the form of either ammonium sulphate or groundnut cake increase the incidence of blast in susceptible varieties.

Over a basal dressing of 5,000 lb. green leaf, application of nitrogenous manure should be limitd to a maximum of 40 lb. nitrogen per acre in the case of a susceptible strain like Aduthuria 10, whereas it could be raised to 80 lb. for resistant varieties like Co. 4.

Study of factors contributing to disease resistance in two susceptible and two resistant varieties, revealed that the former possess slightly thicker cuticle and epidermal layer in addition to a greater number of silicated epidermal cells per unit area of plant surface.

Foot-rot

Twenty-four varieties of rice that exhibited a high degree of resistance to blast disease were tested for foot-rot infection. The seeds were artificially inoculated with a concentrated spore suspension of the fungus and sown in the replicated plots in the nursery. The two strains G.E.B. 24 and Ptb. 7 proved highly resistant, the infection being only up to 1·2 per cent while Co. 10 and Co. 11 were highly susceptible (63·6 to 98·5 per cent) in 1947-48 and 1948-49 seasons. In the other 20 blast-resistant strains, the susceptibility ranged from ·4 to 30 per cent and these were, thus, found to be resistant to foot-rot also.

As the disease is seed-borne, various fungicides were tried to control it. Seeds were artificially infected with the fungus and subsequently treated with various organo-mercury compounds; these were sown in nurseries replicated. When the plants were examined, it was found that while those from untreated seeds had about 90 per cent incidence of the disease, the ones treated with 'Ceresan' and 'Agrosan G.N.' showed as low an incidence as 0 to 0·4 per cent. Largescale demonstration of this seed treatment was made in Gobichettypalayam *taluka* of Coimbatore district. Treated seeds sufficient to cover 750 acres in 1947-48 and 1,000 acres in 1948-49 were distributed to cultivators in this area free of cost. The crop raised from these seeds was completely free from the disease. (R.S.).

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Can goat tissue vaccine for rinderpest be prepared under make-shift arrangements when a properly equipped laboratory is not available?

A. Any biological product as a matter of fact should satisfy certain standards of potency, safety, purity, etc. to be efficient and trustworthy. Unlike some other countries, we do not have in India a standard laboratory to test the various veterinary biological products prepared. So, the manufacturers are morally bound to see that their products satisfy all the conditions required. In order to ensure the proper standards, the preparation of biological products should be undertaken in well equipped laboratories by properly trained personnel.

Very often in India, to satisfy local needs and due to difficulties in transport, etc. the preparation of products like goat tissue vaccine is undertaken as a temporary measure in ill-equipped laboratories. But the dangers of preparation of biologicals under unsuitable conditions even by efficient well-trained persons are many and these have been pointed out many a time. Contamination either by non-pathogenic or pathogenic bacteria is one of the important causes affecting the potency and safety of the products. Recently goat tissue vaccine prepared under unsuitable condition was incriminated to be responsible for the death of 5,000 head of cattle in one of the neighbouring countries and serious outbreaks of pasteurellosis and anthrax have occurred in India as well in connection with rinderpest immunization. Such biologicals not only bring irreparable discredit to otherwise good and efficient products but also disturb public confidence which to a very great extent hampers the programme of control and eradication of infectious diseases.

To maintain national wealth and prestige, it is advisable that no Government or public body should undertake the preparation of biological products under undesirable conditions.

What's doing in All-India

EAST PUNJAB

DILBAGH SINGH

WITH the partition of the Punjab the activities of all the beneficial departments of the Government, including the Veterinary Department, received a serious setback. During the last two years the various new problems created by the partition have been successfully tackled. The department is extending its activities to every branch of the Livestock Industry. This note shows the work performed by the Civil Veterinary Department, East Punjab, during the quarter ending 30 June, 1949.

At present in this province (comprising 13 districts) there are 194 Veterinary Hospitals and 29 permanent outlying dispensaries which are being run under trained men. The work performed, during the quarter, in these Veterinary Institutions is given below:

During the quarter ending 30 June, 1949, 3,20,511 cases were treated and 94,844 castrations were performed in different hospitals. Reports were received of 1,289 cases of contagious diseases; of these 104 were of rinderpest, 22 of haemorrhagic septicaemia, 1,159 of foot-and-mouth, three of black quarter and one of small-pox. All these reports were attended to immediately and necessary action taken.

The following inoculations were performed during the period under report: 2,56,677 goat virus vaccinations and 6,123 anti-rinderpest inoculations, 53,850 haemorrhagic septicaemia vaccinations, 4,118 haemorrhagic septicaemia inoculations, 934 black quarter vaccinations and 913 black quarter inoculations. The Veterinary Vaccine Institute which was started last year at Dagshai in order to meet the demands of sera and vaccines, produced 3,26,400 doses of goat virus tissue vaccine. This vaccine was used in the province of East Punjab, Delhi and Himachal Pardesh for immunizing livestock against cattle plague.

DILBAGH SINGH is Personal Assistant to the Director of Veterinary Services, East Punjab.

Livestock breeding

The Livestock Farm, Hissar, continued to issue pedigree bulls for breeding purposes to various districts of the province. The number of approved District Board cow-bulls at the end of June was 6,257, while the number of approved District Board buffalo-bulls was 2,653.

With the partition of the province, the Montgomery breed was lost to the East Punjab. In order to meet the demand of the people, the Government has started to breed Sahiwal cattle with a basic herd of 50 cows in the Farm. It is hoped that within the next few years good Sahiwal milch cows and heifers will be issued to the public.

With a view to improve buffalo breeding in the province, a buffalo breeding section with a basic herd of 100 buffaloes has been started at the Livestock Farm, Hissar. After some years pedigree buffalo-bulls will be issued to livestock owners for grading their own livestock. The Livestock Farm continued to issue bulls, cows, heifers, donkey stallions, Bikaneri and Hissardale rams and ewes and Betal goats for breeding purposes. A number of good animals for breeding purposes was purchased by the surrounding provinces and States.

In the Dairy Section of the Livestock Farm, Hissar, 2,00,831 lb. of milk was produced during the quarter under report. The income realized from the sale of milk amounted to Rs. 40,388 as. 10.

Dairy development work

The staff sanctioned for dairy survey work remained busy in the collection of data about milk production and its consumption. Technical advice to dairy farmers, managements and *gaushala* managers was offered by the staff. Two hundred and fifty-six lectures on various aspects of dairying were delivered. The survey done so far reveals that *per capita* consumption of fluid milk in important towns of the province is as given below :

Amritsar	3·9 oz.
Gurgaon	5 ,,
Karnal	6 ,,
Simla	3·8 ,,
Dharmsala	4·3 ,,
Rupar	5·5 ,,
Ferozepore	4·7 ,,
Ludhiana	5·6 ,,
Gurdaspur	6·4 ,,
Hoshiarpur	7·6 ,,
Rohtak	5 ,,
Jullundur	6·5 ,,
Hissar	5·01 ,,

This shows that the consumption of milk in big towns is far from satisfactory. In order to produce more milk the Government has approved of a scheme which will go a long way to improve the dairy industry in the province. Under the scheme loans of rupees five thousand or more will be advanced on the following conditions :

1. All animals purchased shall have to be immunized against contagious diseases as advised by the Veterinary Department.
2. Proper record of breeding and milking must be maintained.
3. Only bulls approved by the Veterinary Department shall be used for breeding purposes.
4. All disapproved male stock shall have to be castrated.
5. If land is purchased out of the money given on loan, fodder as recommended by the Veterinary Department shall have to be grown.
6. The money could be utilized either for the purchase of milch animals, dairy equipment or for construction of sheds.

The following schemes, which are likely to augment the production of milk have been submitted to the Government :

1. Establishment of two Model Dairy Farms.
2. Establishment of a Dry Stock Farm.
3. Establishment of segregation camps for old and unproductive cattle.
4. Formation of Dairy Development Board and creation of Dairy Development Fund.
5. Establishment of dairy colonies.
6. Scheme to be financed out of the East Punjab Post-war Services Reconstruction Fund to help ex-service men beneficiaries to earn their livelihood or to increase their income by keeping good milch cattle and by proper disposal of milk.

Gaushalas

The *gaushalas* were visited by the staff. Free technical advice to the management was given. It was pointed out to the people concerned that these *gaushalas* should be run on scientific lines. The Government has formed two *Gaushala* Development Boards, one for each division of the province, who will submit proposals for effecting improvement in efficient working of existing *gaushalas*.

Cattle fairs

Thirty-four cattle fairs at various places in the province were held during the quarter under report. A large number of cattle was bought and taken to other provinces of the Indian Union. Particulars of a few of these fairs are given below :

Name of fair	No. of animals entered	Animals sold
Kosli, Dist. Rohtak ...	10,465	1,449

	For bullocks	For buffaloes	For camels
Highest price	Rs. 860	Rs. 650	Rs. 920
Lowest price	Rs. 82	Rs. 52	Rs. 300

The District Board derived Rs. 10,498 as income from sale fee of livestock. Rupees 249 were distributed as prizes to the owners of selected animals.

	No. of animals entered	Animals sold
Bahadur Garh Cattle Fair	19,671	3,800

	For bullocks	For buffaloes
Highest price	Rs. 1,000	Rs. 900
Lowest price	Rs. 60	Rs. 20

One person alone from Jodhpur State bought 200 bullocks. Rupees 32,798 were derived as income by the District Board, Rohtak. Rupees 322 were given away as prizes to the owners of best animals.

	No. of animals entered	Animals sold
Dharuhera, Dist. Gurgaon	9,888	132

	Highest price	Lowest price
Bullocks ...	Rs. 740	Rs. 239
Young stock ...	Rs. 610	Rs. 142
Buffaloes ...	Rs. 300	Rs. 128
Camels ...	Rs. 600	Rs. 300

Rupees 75 were distributed as prizes.

Poultry husbandry

In the East Punjab there is a Government Poultry Farm at Gurdaspur with its three Sub-stations at Ambala, Jullundur and Kangra. Last year the poultry husbandry work was transferred from the Agriculture to the Civil Veterinary Department. The total number of birds at these Poultry Farms is about two and a half thousands. Every endeavour is being made to increase the number of birds at each poultry station. During the period under report 5,364 eggs were produced. These were sold to public for table and breeding purposes. Nine hundred and fourteen birds were issued from these Poultry Farms to the public for breeding purposes. From the sale of birds and eggs during the quarter under report Rs. 2,387 as. 11 p. 6 were realized. In order to produce more birds and eggs, and thus to help the grow more campaign in the province, the following schemes have been put up to the Government for sanction :

1. Scheme for the establishment of a Poultry Breeding and Research Station at the Government Livestock Farm, Hissar.
2. Scheme for starting eight new Poultry Farms and converting the existing three Poultry Sub-stations at Ambala, Jullundur and Kangra into regular Poultry Farms in order to provide one for each district.

Fisheries

This branch of livestock industry was first under the Agriculture Department, but from April, 1949, it has been amalgamated with the Veterinary Department. Under the Fisheries Act, 3,729 licenses were issued to the public for fishing during the period under report. The amount of fee realized was Rs. 18,333 as. 8. About 544 maunds of fish was caught and marketed in big towns. The sale proceeds which accrued to Government amounted to Rs. 5,602 as. 13 p. 9.

East Punjab Veterinary College, Hissar

A camp Veterinary College at Hissar was started in February, 1948. It has now been put on a permanent basis. Such of the students who passed the final B.V.Sc. examination have been absorbed in the Civil Veterinary Department, East Punjab.

Research Schemes

The following Research Schemes are going on in the province. The results so far achieved will be published in the Annual Reports.

1. Scheme to supplement livestock investigation at the Government Livestock Farm, Hissar.
2. Scheme for the appointment of Veterinary Investigation Officer.
3. Scheme for the investigation of sheep and goat diseases in the East Punjab; appointment of Assistant Disease Investigation Officer (Sheep and Goats).
4. Scheme for the investigation of poultry diseases in the East Punjab; appointment of Assistant Disease Investigation Officer (Poultry).
5. Scheme for indigenous goat breeding at the Government Livestock Farm, Hissar.
6. Scheme for sheep breeding and Wool Analysis Laboratory at the Government Livestock Farm, Hissar.
7. Scheme to evolve a Punjab type of Angora goat by cross breeding.

INDIAN DAIRY RESEARCH INSTITUTE, BANGALORE

H. LAXMINARAYANA

THE Indian Dairy Research Institute, Bangalore, which has just completed 25 years of its existence, celebrated the Silver Jubilee of its foundation on 8 July, 1949. His Highness the Maharaja of Mysore inaugurated the function, which was attended by a large number of distinguished guests including the Dewan and other members of the Mysore Cabinet, high officials of the Mysore Government, eminent citizens of Bangalore and ex-students of the Institute. Shri K. L. Punjabi, Shri N. T. Mone and Sardar Datar Singh from the Central Ministry of Agriculture had come to participate in the celebrations.

His Excellency the Governor-General of India had sent a special message for the occasion wishing success to the Institute. He observed that study, research and experiments were necessary in the selection and maintenance of good cows as well as in other matters, which were once simple and which had now become difficult. This provided the justification for the Indian Dairy Research Institute and the need for maintaining it at a high standard. The Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, in his message wished that the Institute would have many years of useful research and would continue to work for the development of the cattle wealth of our country.

Work of the Institute

In welcoming His Highness the Maharaja and other guests, Dr K. C. Sen, Director of the Institute, narrated the events connected with the establishment and development of the Institute and the various trials it had to undergo before reaching its present status. He also referred to the proposals for the reorganization of the Institute, which had been under the consideration of the Government of India for a long time, and the unsettled conditions under which the Institute had been functioning. Dr Sen pointed out that in spite of the obvious limitations from which the Institute still suffered, it had carried on its pioneer work of training and research for the last 25 years. It had attracted students from all parts of India and also from the neighbouring countries, and many of these students now occupied important positions either under the governments or in the trade. The pedigree stock of animals developed at the Institute had won high reputation all over India and the animals were in great demand in the neighbouring provinces for grading up local cattle. An artificial insemination centre had been established at the Institute, which had been doing valuable work in improving the quality of local village cattle. Explaining the special nature of problems connected with dairying in India, which called for intensified dairy research work in this country, Dr Sen referred to the contributions made by the Institute in this direction and the investigations carried out by its research workers. He added that applied dairy science could make a fundamental contribution in solving the present food crisis in the country by increasing the production of milk and by ensuring its proper utilization. Its development was, therefore, of primary importance to the country.

Inaugural address

The Maharaja of Mysore, in the course of his inaugural address, referred to the vital role of the Institute in the economy of the country, in improving the standard of living of the people and in arresting the deterioration of human vitality, particularly of children. The various activities of the Institute were all calculated to achieve the purpose of better yield of milk from improved breeds of cattle. Owing to a variety of reasons, the position of milk supply in the country had become very unsatisfactory. There was need for increasing the number of milch cattle, for improving the milk yield of such cattle and for the proper distribution of milk under hygienic conditions to remote areas. These were some of the problems which had to be solved and which formed the subject of research at this Institute. His Highness then referred to the importance of fundamental research as a preliminary to real utilitarian research in applied sciences. He hoped that both the types of research would be carried on simultaneously and with equal vigour in the Institute and that this Institute would form the central nucleus of all schemes calculated to improve the yield of milk and the preparation of dairy products.

After the inauguration of the Silver Jubilee, the Maharaja performed the naming ceremony of some calves to commemorate the occasion. The Maharaja and other guests were conducted round the farm and research sections and the various activities of the Institute were explained to them.

Present day milk supply

As a part of the Silver Jubilee Celebrations, a scientific symposium on 'The present day problems of milk supply' was held on 9 July, 1949. Sardar Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, presided over the meeting. A number of speakers, who were specialists in the line, participated in the discussion and presented their views on the different aspects of the problem.

In the course of his introductory remarks, the President referred to the wide gap existing between the quantity of milk production in the country and the nutritional needs of the people and warned that unless early steps were taken to solve the problem, the situation would go completely out of hand. He drew attention to the need for the development of a cheap and efficient method of preserving and transporting milk, for the organization of milk production on scientific lines and for exercising of greater vigilance by health authorities.

Speaking on the position of milch cattle in village economy, Rajasevaskta A. K. Yegna Narayan Aiyer, retired Director of Agriculture, Mysore, deprecated the growing tendency of replacing the local breeds of cattle in the villages by cross-bred animals on account of the superior milking quality of the latter. Since bullock-power would always remain indispensable for farm work in this country, it was imperative that the local breeds of cows should be conserved in the villages and improved, while cross-bred cattle could be maintained in urban areas and in special mi colonies for profitable milk production. Buff loes, which formed the actual dairy anima in villages, should be removed from the citi and maintained in villages where the cond tions were more congenial to them. Mr. Aiy also emphasized the need for taking urge steps to relieve the present shortage of catt feeds in the villages.

Mr. R. L. Kaura, Director of Anim Husbandry, United Provinces, advocated t establishment of key village blocks for inte sive cattle breeding work and the transf of unproductive stock to concentration cam in forest areas in order to save cultivat fodder crops for the use of productive catt only.

The advantages of artificial inseminati for bringing about a rapid improvement the milking quality of local cows were de cribed by Mr. S. V. Chandiramani, Artific Insemination Officer. In his experimen with village cattle at Bangalore, he was ab to achieve nearly 60 per cent successf inseminations, which compared favourab with the results obtained in other countrie In order to derive the maximum bene from this process, it was essential to emplo carefully selected sires, to castrate all uncer fied bulls and to ensure proper feeding a management of the progeny obtained throu artificial insemination.

The problems involved in the collecti and transport of milk from villages to tow were then discussed by Dr S. C. Ray, Dai Technologist at the Indian Dairy Resear Institute. Based on the results of resear work at the Institute, a number of improv ments in the existing methods were suggest by him.

In connection with the improvement the urban milk supply, Mr. D. N. Khuroc Milk Commissioner, Bombay, offered so valuable suggestions. He outlined the ste that were being taken by the Bombay Gove ment for the removal of 15,000 cattle fr the Bombay city and their colonization a suitable place outside Bombay where mode dairy farms would be established and run cooperative lines. The Government h taken control of the collection and distributi of milk in the city and were also supplyi 'toned milk' to the poorer classes of peo at cheaper rates. He urged that similar ste hould be taken in other cities.

The nutritional importance of milk with articular reference to the deficient cereal liets in India, the role of milk as a potential arrier of diseases and the importance of ndertaking early steps for improving the uality of milk supply in the country were ther important items discussed at the meeting. n winding up the symposium, the President remarked that very valuable information on many outstanding questions bearing on the nation's milk supply position had been brought out during the discussions. He also congratulated the Director, members of staff and students of the Indian Dairy Research Institute on the successful organization of the symposium and the Jubilee Celebrations of the Institute.

CENTRAL *GOSHALA* DEVELOPMENT BOARD

THE reorganization of the existing 3,000 *goshalas* and *pinjrapoles* into useful cattle breeding and milk producing centres has been undertaken as part of the programme of the development of cattle wealth in this country. Provision has been made to organize these institutions into Provincial and State Federations in order to secure coordinated action and mutual aid in these matters. It was anticipated that when most of these Provincial Federations had been formed, a Central Organization would be necessary in order to coordinate the working of these institutions for their development on uniform lines. So far as the first part of the scheme is concerned, the Provincial Federations have been formed in most of the provinces. Time has now come to complete the structure by the appointment of the Central Organization. Government of India hereby appoint a Central *Goshala* Development Board consisting of the following members :

(1) The Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture .. *Ex-officio* Chairman

(2) Sardar Datar Singh, Additional Secretary and Cattle Utilization Adviser, Ministry of Agriculture .. .. .. *Ex-officio* Vice-Chairman

(3) One representative of each of the provincial and State Governments where the Federation of *Goshalas* and *Pinjrapoles* have been formed.

(4) One representative of each of the Provincial and State Federations.

(5) Deputy Cattle Utilization Adviser to the Government of India .. .. *Ex-officio* Secretary

Members of the Board shall hold office for a period of five years from the date of appointment.

The Board shall have the following functions :

(1) To advise, coordinate and assist the provincial, regional and state federations in their programme for the development of *goshalas* and *pinjrapoles*.

(2) To review periodically the progress of the *goshala* development schemes in the provinces and States and to plan a coordinated programme for the whole of the country.

(3) To educate and organize public opinion for the development of these institutions on proper lines.

(4) To take such other measures for the development of *goshalas* and *pinjrapoles* as are considered necessary.—(*P. I. B.*)

Across the Borders

SCIENCE IN THE SERVICE OF AGRICULTURE[*]

By E. C. STAKMAN

AGRICULTURE is fundamental to human subsistence. A primary service that science must render to agriculture is to emphasize the importance and peculiar character of this basic industry, for indeed man is dependent on plant growth—on photosynthesis—for his very existence on earth. Because farming is a complex biological enterprise, subject to tremendous climatic and biotic hazards over which the individual farmer can exercise little or no control, a successful agriculture needs the services of all science. Government-supported science is especially needed because in most countries farming is carried on in many relatively small units. By its very nature, farming cannot be concentrated like processing and manufacturing In the United States alone there are about 6,000,000 farms distributed over an area of about 3,000,000 square miles, with so many kinds and combinations of plants, animals, soils, and climates that nearly 500 types of farming can be recognized.

Utilizing results of research and invention

During the war years, 1942 to 1945 inclusive, American farmers produced about 2,000,000,000 bushels more corn than would have been possible during four years of World War I; it is estimated that the efficiency of animal production during World War II was 25 per cent higher than in 1919; the use of farm machinery in World War II released enough land previously used for work animals to feed 16,000,000 cattle or 26,000,000 hogs, so badly needed for dairy products and beef and pork; an idea of the number of men released for other types of national service by the mechanization of farming can be gained from the fact that in 1900 the production of 100 bushels of wheat required 108 hours of man labour and only 47 hours in 1940. This progress was made possible almost entirely by utilizing the results of research and invention.

Corn, wheat, and oats are outstanding examples of crop plants that were so improved as to contribute greatly to agricultural production during the war years. There are many others, but these illustrate progress attained through the application of the principles of genetics to plant improvement. Without hybrid corn there could have been no 3,200,000,000-bushel crop in 1946. The 600,000,000 extra bushels that go to the credit of hybrid corn in 1945 and the 2,000,000,000 during the war years constitute an astonishing record. But more amazing is the scientific record, especially the rapidity of the progress after the underlying principles were developed and applied. Experiments in crossing varieties of corn were made as early as 1881, but inbreeding experiments were begun as late as 1905, and the crossing of inbred lines about 1908. Information basic to the development of hybrid corn was originally obtained as a result of natural curiosity regarding the effects of inbreeding. The scientific study of corn genetics and its practical application in breeding followed. The results have enriched the science of genetics and the agriculture of many countries. In the United States only 0·1 per cent of the corn acreage was planted to hybrids in 1933; now it is almost 100 per cent in the cornbelt states, with an average increase of about 20 per cent in yield over that of the open-pollinated varieties grown 15 years ago.

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Rust-resistant varieties

In the interim between the two world wars the terribly destructive stem rust of wheat was brought under at least temporary control in the hard red spring wheat region of the United States and Canada through the use of newly produced rust-resistant varieties and the eradication of rust-susceptible barberry bushes. It is true that there were extremely destructive epidemics in 1935 and 1937 because of a series of extraordinary meteorologic events, and because of the appearance of a new parasitic race of the rust that ended the short but useful career of the best spring wheat variety then grown. Other varieties were ready, however, to meet the new menace, and they helped make the badly needed billion-bushel wheat crops possible. The production of these rust-resistant varieties was made possible only because plant breeders and plant pathologists had learned enough about the genetics of the wheat and of the rust fungus to proceed intelligently in the work of breeding and testing.

The oat varieties of World War I could not have performed as did those of War II, even though the latter barely survived the war. A number of superior varieties were obtained by crossing the varieties Richland and Victoria. Richland contributed stem-rust resistance, and Victoria contributed crown-rust resistance. These new varieties became extremely popular in most oat-growing States in the early 1940's because they often yielded 20 to 50 per cent more than the varieties that they replaced. They served well until the end of the war. Now they are doomed to oblivion because of their extraordinary susceptibility to a disease that was unknown until they became widely grown. But breeders and pathologists had been crossing still other oat varieties because they knew that the Richland-Victoria group of hybrids was menaced by parasitic races of the stem-rust fungus that increased in prevalence as the acreage of the new varieties increased.

Science has given agriculture hundreds of improved varieties of plants within the past few decades. But these varieties cannot perform to their maximum capacity unless grown on suitable soils and under appropriate climatic conditions. It is common knowledge that some plants, such as clover and alfalfa, will not grow well on acid soils and that certain kinds, such as blueberries and cranberries like an acid soil. Well known, also, is the fact that all plants require nitrogen, phosphorus, potassium, calcium, and certain other nutrient elements and that they must be available in proper proportions. Progress is continually being made in determining the peculiar requirements of various kinds of soil and plants.

Role of minor elements

Plants, however, also require minute quantities of boron, copper, sulphur, manganese, zinc, and certain other elements for normal growth. The causes of many mysterious and destructive deficiency diseases of plants have been revealed by increasing knowledge regarding the role of these minor elements. Thus, a dry rot of sugar beets and certain other plants is now known to be caused by lack of boron and can easily be prevented by supplying it to the soil. Likewise, the internal core of apples, internal browning of cauliflower, top rot of tobacco, and cracked stem of celery can all be prevented by adding small amounts of boron to the soil. A slight excess, on the other hand, is deleterious. Deficiency of copper causes wilting of the upper leaves of tobacco and unthriftiness of certain other plants. The addition of small amounts of manganese to certain soils makes the difference between a good crop of tomatoes and virtual crop failure. Deficiencies of iron, copper, and cobalt in soils are known to retard the development of cattle that feed on plants grown on such soils. Until recently these minor elements were not added to commercial fertilizers, but now, with more precise information, attempts are being made to add them in the proper amounts. Minute quantities of certain elements in soils may be poisonous to plants or animals. Among them are arsenic, selenium, thalium, and molybdenum.

Even when the best varieties are grown on the best soils, crop plants still are subject to the destructive effects of unfavourable weather, insect pests, and plant diseases. Although science has not yet learned to control weather, it has helped reduce its destructive effects by providing better-adapted varieties of plants and better tillage methods. The substitution of *sorghums* for corn in the drier parts of the Great Plains region of the United States and of hardier varieties of wheat for less hardy varieties in much of this area, has helped greatly to ensure production. The continual introduction or production of better winter-hardy and drought-resistant grains, perennial forage grasses, and legumes is helping to ensure and stabilize production. Even the production of non-shattering varieties of grain has reduced grain losses and made possible the use of combines, which cut and thresh the grain in one operation, thus saving a great amount of labour.

Insects, like weather, may cause devastating damage in a short time. Great progress has been made in efficiency and economy of controlling many of these insects. The cotton boll weevil, for example, which almost ruined the cotton industry in large areas of the American South, has been brought under reasonable control by a combination of suitable varieties and airplane dusting with insecticidal dusts. Varieties of wheat have been produced that are far more resistant to the Hessian fly and chinch bugs than those formerly grown. There has been a remarkable record of achievement in the production of more effective insecticides, such as the well-known DDT and others. But many of these insecticides bring with them new problems, for they may be injurious to certain kinds of plants and may poison the soil when used in large quantities. They may even be dangerous to man when not completely removed from fruits and vegetables. There still is urgent need for extensive research on the better control of insects.

New rust races

Plant diseases caused by viruses, bacteria, and fungi are a continual menace to all kinds of crop plants. Some of the most destructive and typically epidemic, such as the rusts of wheat and other small grains and the late blight of potatoes and tomatoes, can spread with frightening rapidity and devastating effect. As an example, stem rust of wheat and other grains and grasses is caused by a fungus. The individual farmer is helpless to prevent its spread. Study of the rust revealed that it was carrying on an extensive breeding programme of its own. More than 200 races of the wheat variety of stem rust are now known. A wheat variety may be immune from some races, moderately resistant to others, and completely susceptible to still others. As the prevalence of races may vary from place to place and from year to year, a wheat variety may be resistant here but not there, and then but not now. Worse still, new races are produced continually by a process of hybridization between existing races, for the rust fungus, like wheat, has a sexual stage. Fortunately, the sexual stage can develop only on a relatively useless plant, the common barberry; hence the barberry-eradication campaign, which has reduced the number of races and delayed the onset of rust early in the growing season in the northern half of the United States.

As rust can exist independently of barberries in certain areas of southern United States and Mexico and then spread northward in the spring and early summer, barberry-eradication must be supplemented by the use of resistant varieties of wheat and other grains to attain practical control of the rust. It has, however, been impossible to eradicate all barberries, and numerous new rust races are continually being produced. Accordingly, plant scientists are trying to prepare against possible future emergencies by making extensive series of crosses in an attempt to produce varieties that can resist all races of rust now known, whether important at present or not.

Despite many difficulties, great progress has been made in controlling plant diseases. The production and utilization of resistant varieties of plants, even though they may be of only temporary or regional value, have greatly reduced the danger of catastrophe from plant-disease epidemics. Moreover, many diseases can be controlled at least fairly well by appropriate crop rotations, the treatment of seeds and other propagative plant parts with fungicidal chemicals, and the spraying or dusting of growing plants with similar substances. During the past 30 years improvement in fungicides has paralleled that in insecticides.

Animal production

When once soil, weather, and man have combined to produce good plants, as scientifically as possible, the problem of the proper utilization of the plant products still remains. As animal production is one of the most important phases of agriculture, the methods of conversion of feed and forage into meat and milk and other animal products should be as scientific as possible. Continual progress is being made in learning more about the nutritional requirements of different kinds of farm animals and the reasons why feed or forage from certain regions often gives better results than that from others. Phosphorus deficiency is a fairly common disorder, and the addition of 6 to 14 grams of phosphorus a day to feed for calves and cows in southern Texas has had remarkable results. Animals, like plants, require some of the minor elements and sometimes suffer from deficiency.

Increased knowledge of animal diseases has kept the disease hazard within reasonable limits in the United States for a number of years. Hog cholera, which in 1897 killed one pig in seven in the United States, is still present but is now controlled by vaccination. Other diseases, such as anthrax, brucellosis, swine erysipelas, tuberculosis, and mastitis, have been kept under reasonable control by a combination of sanitary procedures, the use of vaccines, and of drugs such as the sulphur drugs and penicillin. Foot-and-mouth disease, which appeared in limited areas in the United States in the past, has been eradicated and then kept out by appropriate quarantine measures.

To avoid diffuseness and glittering generalities, this discussion has dealt largely with the importance of agriculture in the United States. What has been said has equal importance to international questions in agriculture. Can we develop a scientific and ethical attitude toward global problems of human subsistence ? Until we do we can hardly expect to see the emergence of One World. And if we wish to attain this goal we shall have to face facts and alleviate desperate situations with scientific realism and true justice.—Released through *USIS*.

THE 'LET-DOWN' HORMONE IN DAIRY COWS

THE milk of the cow is let down by the contraction of muscles round the alveoli forcing the minute quantity of milk in each of the many million alveoli in the udder down the ducts into the milk cistern. It is only the milk in the milk cistern which can be drawn by the calf, hand milker, or milking machine, when the pressure of the milk inside the udder is high enough to force the milk through the sphincter muscle near the point of the teat.

The hand milker forces the milk out by imprisoning milk in the teat and applying pressure until the sphincter muscle yields and lets the milk out. The teat is released so that it can re-fill and then the milk is forced out again and so on. The calf and the milking machine draw the milk by suction. The sucking action of the calf and the pulsation of the milking machines massage the teats to keep an active circulation of blood running through them.

When Dr W. E. Petersen, Professor of Dairy Husbandry, University of Minnesota, U.S.A., was in Victoria last December, he explained how the cow produced her milk and how it should be obtained from her.

The contraction of the muscles round the alveoli is caused by the hormone, oxytocin, when the cow relaxes for milking. The act of nursing the calf is the natural stimulus for the release of the let-down hormone and the cow should be trained to release the hormone at milking time as freely as she would when the calf would line up to suckle.

The training of the cow to release the hormone is one of the most important tasks in the milking shed. Cows which let their milk down freely can be milked quickly and will be the highest-producing and most profitable cows. Training the cow is mainly a matter of gaining her confidence and treating her kindly. The massage and washing of the udder with a cloth and warm water and the drawing of jet from each teat assist the cow to involuntarily release the oxytocin.

Dr Petersen has found that the hormone requires about 45 seconds to travel from the pituitary gland, where it is produced near the brain, to the udder and cause the muscles to contract. The effects of the hormone last for only seven minutes, and milking must be commenced and completed while the stimulus is operating. The machines should be put on one minute after the stimulus is applied and removed as soon as the milk ceases to flow, but before removing the machines the teat cups should be held down with one hand and each quarter of the udder massaged downwards towards the teat with the other hand.

An important part of the training is to train the cow to let all her milk down to the machines and completely eliminate handstripping. Dr Petersen emphasized the need to train the cows to milk out without handstripping. Handstripping frequently leads to incomplete let-down to the machines as the cow involuntarily waits for a second stimulus when handstripping commences.

The cow should not be disturbed or upset during milking. Upsets may stop the release of the hormone and prevent the let-down of milk. The cow is then said to hold up her milk.

If the teat cups are left on after milk flow ceases, the inner linings of the teat are apt to be rubbed together and be injured. Most mastitis occurs as the result of the causative organisms gaining entry to the tissues through injuries.—*Journal of the Department of Agriculture*, Victoria, June, 1949.

Compiled by A. C. T. HEWITT, M. Agr. Sc., Live stock Science Officer.

Home Gleanings

STABILIZATION OF PLANT NAMES

By V. S. RAO

INTENDING to write a semi-popular book about the common trees of Malaya, I imagined that their botanical names would have been fixed. But I soon discovered that this was far from being the case. Indeed it was not uncommon to find that what was apparently the same tree was referred to by different names by each of several different authors. Thus, when Hooker, Trimen, Valeton, Merril, and other authors of standard systematic works concerning the flora of Malay Peninsula and adjoining territories showed little uniformity in nomenclature, it was not surprising to find the nomenclature of such standard economic works as those of Watt, Heyne and Burkill, to say the least, unreliable. 'For my own satisfaction, I have adopted the principle that no alteration in botanical names should be accepted unless supported by botanical proof by which means only fact, rather than opinion, becomes the basis of argument'.

So wrote Dr E. J. H. Corner* in 1939. The difficulties which confronted Dr Corner are familiar to all those concerned with the study of plant life, and arise from the single fact that the *same* plant is often referred to by different authors by different scientific names in different publications. Even a cursory reading of journals devoted to systematic botany would be sufficient to show how changes in plant names are being constantly made. This is perhaps inevitable in a science like botany which is not an exact science in the sense that mathematics, for example, is. Researches constantly bring out fresh evidence for the validity or otherwise of names, and lead to clearer understanding of the relationships among plants. Unfortunately, however, systematists are far too few and the number of plants far too large, so much so that considerable time and labour will be required for locating all the errors and misapplications perpetuated in literature and rectifying them. In the meanwhile, the difficulty, to which Dr Corner has given such eloquent expression, continues to confront and confuse those concerned with the use of names for designating plant species.

Too often we find that a name published after an apparently thorough search has been changed a few years—sometimes even a few months—later. There have been numerous cases in which the name of a plant has undergone twenty or more alterations. There are instances where a name considered invalid for years has been revived, shown to be valid, and adopted. *Setaria geniculata* (Linn.) Beauv. has 73 synonyms, *Koeleria cristata* (L) Pers. has 41, and *Echinochloa crusgallii* (L) Beauv. has 46. Arber*, a recognized authority on grasses, who examined the botanical names of the pearl millet, says: 'The history of names which have been applied to it (pearl millet) forms an ironical commentary on the botanist's claim that the use of a Latin terminology results in precision of meaning. This plant, early in the nineteenth century, possessed almost as many Latin names as there are floras. It has been called *Pennisetum typhoideum*, *P. alopecuroides*, *P. americanum*, *Penicillaria spicata* and *Panicum spicatum*. Of these *Pennisetum typhoideum* Pers. has been the most popular in recent years**'. This name has since been displaced by *Pennisetum typhoides*, and, in more recent years, *Pennisetum glaucum* has been suggested as the correct name for it. Instances like this are indicative of the confusion involved in designating plants and the imperative necessity for arriving at a definite understanding on the selection and use of plant names.

Differences in the interpretation of rules for naming plants have added to the confusion, and even in cases where only nomenclatural, not taxonomic, issues are concerned, different names have been considered valid by different botanists for one and the same plant. However, nomenclatural changes are governed, at least to some extent, by international rules, but changes based on taxonomic considerations are beyond the scope of any rules that can be framed. They depend, to a large extent, on the judgement of individual botanists. A valid

* *Gardens' Bulletin*, Straits Settlement, 1939, **10**, 2

***The Graminae*, 1934, p. 24

name of one author may be the invalid name of another, and it is impossible to reconcile them. *Caesalpinia pulcherrima* (L) Swartz and *Poinciana pulcherrima* L. are names of one and the same plant. So are *Chloranthus brachystachys* Bl. and C. *glaber* (Thumb.) Makino; *Cleome icosandra* L. and *Polanisia icosandra* L.; and *Brassica alba* Boiss. B. *hirta* Moench. and *Sinapsis alba* L.

There are other factors which add to the confusion in names. *Cassia obtusifolia* L. has been considered by some to be synonymous with *C. tora* L., while others consider the two to be entirely different plants. This confusion is further heightened by the suggestion that the correct name for *Cassia tora* is *Emolista tora* (L.) Britton & Rose. Similarly, *Cerbera odollam* Gaertn. is considered by some to be synonymous with *C. manghas* L., and others hold that the two are entirely different plants. When authorities differ, whose is the opinion to be accepted by a person who 'uses names as appellations for plants and not as botanical footballs' ?†

Is the confusion deepening?

Discrepancies are not uncommon even in the citation of authorities for plant names. Thus *Calotropis gigantea* is variously cited as *Calotropis gigantea* R. Br. *Calotropis gigantea* (Willd.) R. Br., *Calotropis gigantea* (Willd.) Dryand, *Calotropis gigantea* (Dryand) Ait., *Calotropis gigantea* (Linn.) Dryand, and *Calotropis gigantea* Ait. There can be one and only one correct author citation for this plant name, or for that matter, for any other plant name. All other citations must be wrong.

Protests against too many and too frequent changes in plant names have been made from time to time by botanists and non-botanists alike. Such changes are all the more exasperating when they concern economic plant. Stabilization of plant names is the aim of systematic botanists, but they proceed to achieve this end by discovering the earliest valid name for each plant. Unfortunately, however, names considered 'earliest' at one time have often been found to have earlier valid names, the discovery of which invalidates the existing names although they may have been in use for years. A systematic and rigid application of international rules of botanical nomenclature will result *ultimately* in the stabilization of plant names, but only in those cases where taxonomy is not involved. But even for this, one has to await patiently the results of extensive researches by large teams of workers well provided with ample laboratory, library and herbarium facilities. When we come to the taxonomic aspect, the position is even more discouraging. Studies on the taxonomy of economic plants are in an amazingly backward state. The literature on many genera is confused. Who is to be accepted as authorities when monographers and specialists differ? Errors in a monograph can be discovered only by another subsequent and exhaustive monographic research. Usually they have a tendency to persist and perpetuate themselves!

Can usage be ignored?

The great inconvenience caused by nomenclatural changes, at least so far as economic plants are concerned, has been well recognized and voiced by many botanists. Thus Bailey wrote: 'Botanical names should not be changed lightly for the purpose of regularizing any particular scheme or plan or to make them always conform to an arbitrary set of rules. Botanical names do not belong to botanists to do with them as they will. The public has good rights in these names, and this is particularly true in the names of cultivated plants, for they may then have standardized commercial value. The only stability, of course, is usage, and usage can rarely be forced into hard and fast regulations'††. The insistence on usage and the clear recognition of the purpose served by the names given to plants are noteworthy. Chamberlain, the well-known authority on gymnosperms is reported to have stated: 'We believe that when a name has been established in literature, it should be retained.......... Taxonomists would do well to let familiar, well-established names alone, and not try to revive some forgotten name'.‡ The efforts of botanists should be diverted to the elimination of confusion due to multiplicity and instability of plant names. As Gleason has said: 'If botanists search as assiduously for reasons to maintain a name as they do for reasons to change one, a considerable number of well-known names will be saved '.§

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†Gleason (1947). *Phytologia*, **2**, 202

†† *Standard Cyclopædia of Horticulture*, 1947, **1**, xv

‡ *Chronica Botanica*, 1943, **7**, 439

' Pleas for *nomina specifica conservanda* brought before the International Botanical Congress have not been hitherto accepted. At the last session of the Congress (1935), the proposal was defeated by a majority of 147 votes. It is almost certain that specific names will never be officially conserved. What is feasible, however, is the preparation of an agreed list which all botanists should accept as valid for a specified number of years, and the International Botanical Congress should be accepted as the only authority for introducing changes in plant names. This would minimize confusion and prevent the introduction of hasty changes in names by individual workers. There has been no limit to such changes, and many controversies, often bitter, have centred round the validity of suggested or existing plant names. Confusion can be minimized if authors, who find the need for revising plant names, first obtain the approval and support of an international body of botanists. A resolution passed at the last session (1935) of the International Botanical Congress envisaged the appointment of a Committee to draw up a list of names of economic plants according to international rules, which should remain in use for ten years. This is a step in the right direction. Unfortunately, that list has not been published so far. We trust that the matter would be taken up at the forthcoming session of the Congress, and that effective steps would be taken to introduce reasonable stability in so fundamental a requirement as a name for a plant.—*Journal of Scientific and Industrial Research*, May, 1949.

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§ The preservation of well-known binomials. *Phytologia*, **1947, 2,** 203

FISH LURED BY LIGHT ARE NETTED IN SHOALS

USING a purse-seine net and strong electric light, a group of fishermen in Victoria, Australia, has been making successful hauls of pilchards. Method is to attract the fish around a powerful light at night, and then encircle them with a large net of the purse-seine or lampara type.

The light is effective only when there is not much moon.

Boat equipment consists of a 32 ft. vessel of 21 h. p., which tows two dinghies to a likely fishing area.

A wooden stand with two 1,000-candle power electric lamps and reflector is then assembled and put into one dinghy, which has anchored some distance from the other boats. One man stays in it to watch for signs of fish.

Electricity is provided by a generator which is belt-driven from the engine of the large boat, through a cable which is buoyed to float on the water.

Meanwhile, the net is made ready for shooting in the other dinghy.

After an hour or two, fish may be observed densely congregated around the lights, and the watcher gives the signal when he thinks there are reasonable prospects of a good catch. The second dinghy is then quietly rowed around the shoal and the net is laid out.

The net is a small purse-seine of ½ in. mesh webbing, 110 fathoms long and 17 fathoms deep. It is lightly leaded for a purse-seine, because pursing has to be done by hand with only four men and when lights are used, the fish are so attracted that they ignore or do not realize their danger until too late.

Darkness also conceals the other boats.

The net is pursed and hauled entirely from the dinghy. When pursing is complete the ' light boat ' is rowed out of the circle of netting.

This work began at the end of April and is being continued. There have been no failures and the average haul has been about one ton of fish .—*Australian Agricultural Newsletter*, No. AGN /266.

Book Reviews

TEXTBOOK OF WOOD TECHNOLOGY (VOL. I)

By H. P. BROWN, A. J. PANSHIN and C. C. FORSAITH. (McGraw-Hill Book Company, The American Forestry series, price six dollars.)

PROFESSORS Brown and Panshin wrote in 1934 a book on 'Identification of the Commercial Timbers of the United States'. This was revised and enlarged in 1940 under the title 'Commercial Timbers of the United States'. The present textbook replaces the two earlier publications and is entitled 'Textbook of Wood Technology'. Professor Forsaith here joins with the earlier authors in writing up the book. The first volume which is under review deals with more or less the same topic as the earlier text. The second volume will include physical, mechanical and chemical properties of wood.

There are altogether eighteen chapters. After giving some general information on plant and wood, the authors deal with 'How a tree grows'. Here considerable information is given and this will, undoubtedly, lay a sound foundation for what follows later in the book. Then the gross features and the minute structure of wood, both coniferous and porous, are given. In the chapter on 'Variable quality of wood within a tree-species', an attempt at brevity is noticed. Considerable research work on various aspects of this subject has been done in the Forest Products Laboratories located in different parts of the world. It would have been useful if all that has been done and that are being done were included here. It is hoped that the authors will see to this in the next edition. Information on this subject is always useful to practical men. Then follow chapters on 'Figures in wood' and 'Defects in wood'. There are also three keys included in the book. The first one can be used by those who examine the wood with the naked eye or a hand lens. Excellent photomicrographs (x 5) are given here. This will, undoubtedly, help in the easy identification of timbers. The second key is for use with the help of a microscope. Here some very useful photomicrographs are given depicting important anatomical structure which are used for microscopic identification of timbers. The third key is meant for combined gross and minute features. Lastly, there is a chapter on the description of 77 North American timbers, along with cross and tangential photomicrographs taken at x 75. Altogether it is a welcome publication on wood anatomy. The authors and the publishers are to be congratulated for producing such an excellent book for students in forestry in the United States of America.—(K.A.C.)

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COMMERCIAL BOOK-KEEPING

By SHRI BABU LALL KHANNA (Khyaliganj, Lucknow, pp. 131, Rs. 2 as. 8).

THE book gives the principles of Book-keeping in a concise form. These have also been illustrated by examples where necessary. The book is divided into ten chapters with an appendix at the end. Chapter X deals with definitions of important mercantile terms, whilst the appendix gives a number of useful exercises together with their solutions. The book is well written and should serve as an useful guide to officers placed in charge of accounts and to others engaged in business. Compared to its utility the price has been kept rather low.

It is hoped the book will be widely used.—(S.C.R.)

AN EARLY PUMPKIN VARIETY

By C. RAJASEKHARA MUDALIAR

As a result of variety trials, an early variety of pumpkin, known locally in Malabar as *vellari mathan*, has been established, and identified as *Cucurbita maxima*, Duchesne var. *badagarensis*, Saker, var. nov.

In Malabar it is cultivated during the period from December to March, but was successfully grown in the period from July to December as well. It is capable of profuse growth, spreading all round up to a diameter of 8 to 10 ft. without any support. So, the pits (1½ ft. in diameter and one foot deep) for the crop should not be dug close to each other. It starts flowering within 40 to 45 days from the time of sowing, female flowers being quite in abundance. Within 90 days flowers mature into fruits fit for harvest. Thus, the whole life cycle for the crop is about 90 to 100 days. So, it has another advantage of being a short duration crop in addition to being very early.

The fruits can be used as any other pumpkin, but are tastier when about half ripe. Besides, they keep well for about two to three months.

Small quantities of seed may be available at the Agricultural Research Station, Pattambi, where it is regularly cultivated as a summer crop.

C. RAJASEKHARA MUDALIAR is Government Assistant Lecturing and Systematic Botanist, Coimbatore.

INDIAN DAIRY DIPLOMA EXAMINATION

THE following is the list of successful candidates arranged in order of merit of the Indian Dairy Diploma Examination held at the Indian Dairy Research Institute, Bangalore, during October-November 1949.

No student has secured 'Honours' marks:

Sanmugam N. (I), Tulpule V. G. (II), Ludar Singh Kanwar (I in Practical), Roy B. N., John A. A., Sen Gupta M., Sherief M. K., Khasim Mohd., Seshagiri A. R., Bopanna A. C., Kalyanakrishnan M. G., Ramesh Chander Saini, Subba Rao S. N., Datta D. R., Rajanna B. N., Lakshmansen Pati, Hari Pada Ray, Devaperiam A., Sharma V. N., Chandrasekhar H. G., Bhargava M. S., Shrikrishna M., Seetharaman R., Codden O. P., Paricharak B. G., Sankaran S., Nagabhushana Rao M. S., Baruah P. K., Dasanna P., Baruah P. C., Das Gupta S. M., Gangadharan B. P., Kulkarni P. V., Gowardhan U. K., Prasanna Kumar Das, Jacob P. C.

The following candidates have passed in Practical only. According to Rule VII sub-para (a) these candidates are permitted to resit for Theory Examination in full in the next examination :—

Garewal A. S., Subbiah C. C., Kunthe R. L.

DEVELOPMENT OF OILSEEDS INDUSTRY

MEASURES to increase the production of oilseeds, improvement of marketing and distribution methods and promotion of export trade in the commodity were the principal items discussed at the fifth meeting of Indian Oilseeds Committee which started its deliberations in New Delhi on October 24, 1949. Sardar Datar Singh, Vice-Chairman, Indian Council of Agricultural Research and President of the Committee, presided.

In his opening address, Sardar Datar Singh remarked that the export trade in oilseeds, which used to earn considerable foreign exchange in the pre-war years had dwindled of late and in 1948-49, the total export amounted to only two lakh tons as against about 8 to 10 lakh tons during the pre-war period. The fundamental factor, he said, responsible for reduction in export trade, was the high price of Indian oilseeds which was, to some extent, due to unregulated speculative activities, hoarding and cornering of stocks. Besides, the internal demand has also gone up considerably causing a rise in the price. 'The most important measure', he said, 'which can be taken to bring down the prices to a reasonable level, therefore, is to increase the production of oilseeds'.

Urging for increase in production, Sardar Datar Singh pointed out that careful crop planning was necessary as, in view of the drive for self-sufficiency in foodgrains as well as in jute and cotton, additional land was not likely to be available for increasing cultivation of oilseeds. Emphasis, therefore, should be laid on increasing the yield from the existing acreage by intensive cultivation methods, application of manures, use of improved seeds, varietal trials, etc.

Sardar Datar Singh hoped that as a result of devaluation of the rupee in relation to the dollar, India's export of oilseeds to dollar areas would be stimulated.

Village oil industry

The Committee considered various schemes for developing the village oil industry and in this connection recommended the establishment of cooperative societies of *tellis* (village oil crushers) in provinces and States. The establishment of a Village Oil Industry Institute at Nagpur was recommended by the Committee and it was suggested that the Institute should, in addition to providing training in oil industry, undertake research work on improved *ghanis* and other allied matters on oil crushing.

Promotion of export

The Committee approved of the principal recommendations made by the Export Promotion Committee on the export of oilseeds and agreed to a change proposed by the latter in the present method of export. Till early this year, when export of Indian oilseeds was governed by the allocation from the International Emergency Food Council, export had to be arranged through established shippers as there were internationally fixed destinational quotas. With the abolition of international allocation, the Export Promotion Committee felt that the need for distribution through established shippers was no longer necessary and that export should be thrown open completely, after fixing a quota for the year.

The Committee also accepted the recommendation of the Export Promotion Committee for allowing free inter-provincial movement of oilseeds.

Various research schemes for increasing the quantitative yield of oilseeds, by improved methods of seed multiplication, were approved by the Committee. A scheme of multiplication and distribution of improved strains of groundnut in Bombay, and various research schemes on oilseeds in the Central Provinces and Berar, the East Punjab, Orissa, West Bengal, Assam, Patiala and the East Punjab States Union, Saurashtra, Madras, Hyderabad and Mysore were recommended. Pests and diseases which cause considerable damage to the crop came in for special consideration and a number of schemes dealing with prevention of pests and diseases were approved. (*P.I.B.*)

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